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1970/72

THE GRADUATE COLLEGE

UNIVERSITY OF ILLINOIS
AT THE MEDICAL CENTER, CHICAGO
CATALOG 1970-72

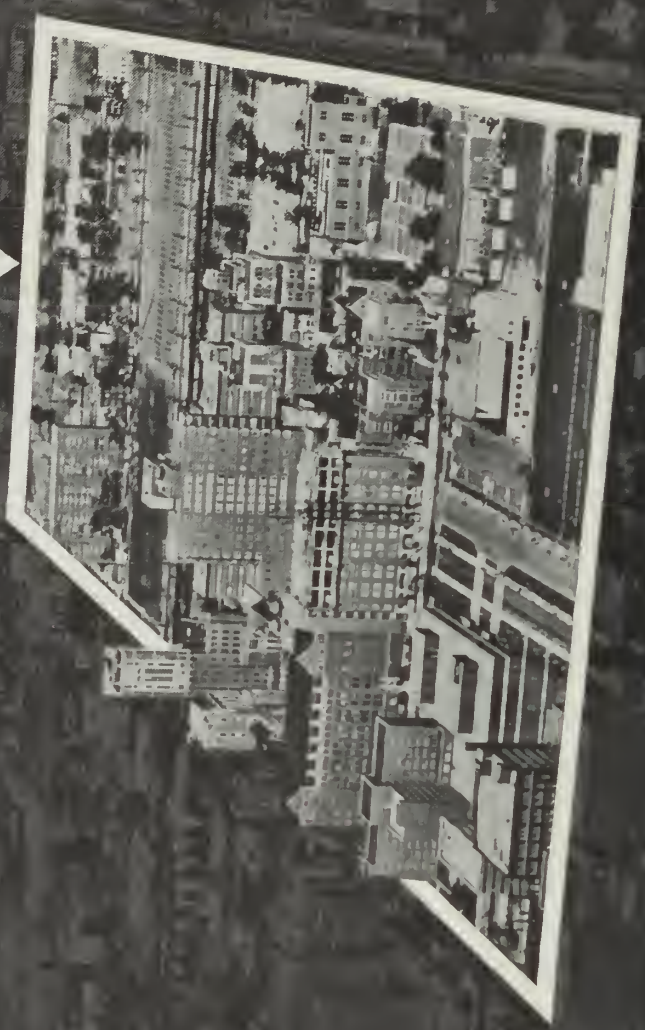
1. Cook County Hospital
2. Presbyterian - St. Lukes Hospital
3. West Side Veterans Administration Hospital
4. Illinois State Hospital Group
5. Eisenhower Expressway
6. Lake Michigan

6

University of Illinois
at the Chicago Circle



University of Illinois
at the Medical Center



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4

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**UNIVERSITY
OF ILLINOIS**

GRADUATE COLLEGE

**AT THE
MEDICAL CENTER
CHICAGO**

1970 - 1972

PUBLISHED BY
THE UNIVERSITY
OF ILLINOIS
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CONTENTS

Board of Trustees..... 4

Administrative Officers..... 5

Calendar 6

University History, Location, and Administration..... 7

The Medical Center..... 7

The Graduate College; Location, History, Organization..... 9

Research Facilities.....10

Library of Medical Sciences.....10

Museums.....11

Recreational Facilities.....11

Housing.....11

Special Educational Opportunities.....15

Objectives and Standards.....15

Admission Requirements.....16

Foreign Applicants.....18

Registration and Program of Studies.....19

The Degree of Master of Science.....23

The Degree of Doctor of Philosophy.....24

Financial Assistance.....29

Scholarships 31

Assistantships 31

Loan Funds.....32

Fees and Expenses.....32

Assessments and Exemptions.....33

FIELDS OF INSTRUCTION FOR THE DEGREE OF MASTER OF SCIENCE

Anatomy	K. Rafferty (Head of Department)	37
Biological Chemistry	A. Nisonoff (Head of Department)	39
Chemistry (Pharmaceutical)	J. E. Gearien (Head of Department)	42
Histology (Dental)	R. Gillette (Head of Department)	47
Medical Psychology	T. J. Tucker (Head of Department)	48
Microbiology	S. Dray (Head of Department)	49
Oral Pathology	J. P. Waterhouse (Head of Department)	53
Oral Surgery	A. G. Anderson (Head of Department)	55
Orthodontics	E. Renfroe (Head of Department)	55
Orthopaedic Surgery	R. D. Ray (Head of Department)	56
Pathology	C. A. Krakower (Head of Department)	57
Pedodontics	D. E. Ore (Acting Head of Department)	60
Pharmacognosy	N. R. Farnsworth (Head of Department)	60
Pharmacology	K. R. Unna (Head of Department)	63
Pharmacy	M. I. Blake (Head of Department)	66
Physiology	A. V. Wolf (Head of Department)	69
Radiology	R. A. Harvey (Head of Department)	72
Surgery	L. M. Nyhus (Head of Department)	73

FIELDS OF INSTRUCTION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Anatomy	37
Biological Chemistry.	39
Chemistry (Pharmaceutical).	42
Microbiology	49
Pathology	57
Pharmacognosy.	60
Pharmacology.	63
Pharmacy	66
Physiology	69

FIELDS OF INSTRUCTION IN PROFESSIONAL DEGREE PROGRAMS

Nursing	Mary K. Mullane (Dean)	75
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MISCELLANEOUS ELECTIVE COURSES.	81
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CALENDAR

1970-1971

1971-1972

FALL QUARTER

Registration	September 21	September 20
Instruction begins at Chicago Circle.....	September 28	September 27
Instruction begins at Medical Center....	September 28	September 27
Thanksgiving vacation.....	November 26-27	November 25-26
Examination period	December 7-11	December 6-10
Registration for winter quarter.....	December 7	December 6
Quarter ends	December 12	December 11

WINTER QUARTER

Instruction begins.....	January 4	January 3
Examination period	March 15-19	March 13-17
Registration for spring quarter.....	March 15	March 13
Quarter ends.....	March 20	March 18

SPRING QUARTER

Instruction begins.....	March 29	March 27
Memorial Day (classes dismissed)	May 31	May 29
Examination period	June 7-11	June 5-9
Commencement	June 11	June 9
Quarter ends.....	June 12	June 10

SUMMER QUARTER

Registration	June 14	June 12
Instruction begins.....	June 21	June 19
Independence Day (classes dismissed) ...	July 5	July 4
Examination period	August 30- September 3	August 28- September 1
Quarter ends.....	September 4	September 2
Deadline for new applicants for admission for fall quarter.....	August 31	August 31

UNIVERSITY HISTORY, LOCATION, AND ADMINISTRATION

The University of Illinois was founded in 1867 largely through the enactment, by the Congress and President Abraham Lincoln, of the Morrill Act which provided 480,000 acres of land from the sale of which funds for the creation and operation of the University were derived.

The University opened on March 2, 1868, as the Illinois Industrial University. Its name was changed to "The University of Illinois" in 1885.

From its modest beginnings, the University has steadily grown to its present distinguished position among the great universities of the United States and the world. The Urbana-Champaign Campus and administrative offices are located 128 miles south of Chicago.

In addition to this, its original location, the University boasts two major campuses on Chicago's near-west side only three-fourths of a mile apart.

The most recently opened campus of the University is the Chicago Circle facility, built on 107 acres of slum-cleared land. This dynamic new campus is expected to provide education opportunities for 20,000 students by 1975. Degree curricula are provided by the Colleges of Liberal Arts and Sciences, Business Administration, Education (including the School of Physical Education), Engineering, and Architecture and Art.

Its graduate courses are offered through the Chicago Circle division of the Graduate College. The close proximity of the Chicago Circle Campus to the Medical Center allows students to study concurrently on both campuses.

THE MEDICAL CENTER

Three-fourths of a mile west of the Chicago Circle Campus in the midst of the 305-acre Medical Center District are the University's teaching, research, and service facilities in the health sciences.

The Colleges of Dentistry, Medicine (including the School of Associated Medical Sciences), Nursing, Pharmacy, and a Graduate College are located at the Medical Center Campus. The University of Illinois Hospital, the Illinois Eye and Ear Infirmary, the Library of Medical Sciences, the Division of Services for Crippled Children, the Medical Research Laboratory, and the Research Resources Laboratory are also an integral part of the campus.

Student enrollment at this campus is consistently around 3,000, with a faculty and staff of approximately 4,000. More graduate courses and degree programs are offered by the Graduate College at the Medical Center Campus than can be found on any other campus of its type.

The Library is one of the largest and most complete health science libraries in the United States.



THE GRADUATE COLLEGE

The University of Illinois offers graduate instruction at its Medical Center in Chicago leading to the degrees of Master of Science and Doctor of Philosophy in the basic sciences of anatomy, biochemistry, pharmaceutical chemistry, microbiology, pathology, pharmacognosy, pharmacology, pharmacy, physiology, and certain applied science areas. The work is intended primarily for the training of men and women for teaching and research careers in the general health science area. Students who obtain graduate degrees in these areas are ideally oriented for positions on the basic science teaching staffs of dental, medical, pharmacy, and nursing schools and for research positions in universities, industry, and research institutes.

Postgraduate refresher courses or other reviews of a strictly professional character are not included in the Graduate College, and no credit toward a Master of Science or Doctor of Philosophy degree is allowed for any type of professional course, review, or routine. Those interested in technical or advanced professional training can find opportunities for this kind of work in the postgraduate curricula offered in certain departments of the professional colleges which may lead to certificates but not to graduate degrees.

LOCATION, HISTORY, AND ORGANIZATION

The Graduate College at the Medical Center is located on the west side of Chicago. The campus, which is about three miles west of the downtown business area, is reached conveniently by elevated train or bus. The work of the College is centralized in the Dentistry-Medicine-Pharmacy buildings facing on Polk, Wood, and Wolcott Streets, and in the College of Nursing Building on Damen Avenue.

The University of Illinois offered facilities for advanced study and research in some fields as early as 1872. Organized graduate instruction under the name of the Graduate School, however, began in 1892. In 1894 the administration of the School was vested in the Council of Administration with the Vice-President of the University as Dean of the School. In 1906 the Graduate School was organized as a separate faculty, and in 1947 it became known as the Graduate College. In 1969 the Graduate College at the Medical Center became an autonomous graduate school with a full-time Dean.

Members of the faculty at the Medical Center in Chicago were first appointed to the graduate faculty in 1924. The Dean of the Graduate College is responsible for graduate work conducted at the professional colleges. The teaching faculty includes members of the University faculty approved to give instruction in graduate courses.

College policies pertaining to graduate work in the medical sciences and proposals for new degree curricula are considered by the Executive Committee and approved by the faculty of the Graduate College at the Medical Center.

Inquiries concerning graduate study in the basic health-related sciences should be directed to the Dean of the Graduate College, University of Illinois at the Medical Center, P.O. Box 6998, Chicago, Illinois 60680.

Students interested in graduate study in areas other than those specified above should address their inquiries to the Dean of the Graduate College, University of Illinois, Urbana, Illinois 61801, or Dean of the Graduate College, University of Illinois at Chicago Circle, University Hall, P.O. Box 4348, Chicago 60680.

RESEARCH FACILITIES

The University buildings contain the administrative offices of the College, the library, lecture rooms, classrooms and laboratories for classwork, numerous small laboratories for individual research, and the clinics and hospital of the University of Illinois. The Illinois Eye and Ear Infirmary, located near the campus, is operated by the University. Close to the campus are the Presbyterian-St. Luke's Hospital, Cook County Hospital, Chicago State Tuberculosis Sanitarium, West Side Veterans Administration Hospital, Illinois State Psychiatric Institute, and the Illinois State Pediatric Institute, all of which are used for student teaching. Hines Veterans Administration Hospital, at some distance from the campus, offers a wide range of learning opportunities.

The University of Illinois Hospital, planned and built for teaching and investigation, connects directly with the classrooms and laboratories of the Colleges of Dentistry and Medicine. The addition, completed in 1953, increased the total capacity of the University of Illinois Hospital and the Neuropsychiatric Institute to 810 beds. Each year there are approximately 200,000 patient visits in the outpatient clinic and 12,000 admissions to the hospital. There are eleven surgical operating rooms, all with facilities for students and some equipped for special procedures. All types of surgery, including dental, are practiced.

The facilities of the Research Resources Laboratory include rooms and an altitude chamber in which ranges of temperature, humidity, and pressure can be controlled, basic medical and physiological instruments, electron microscopes, computer facilities, and other major pieces of research equipment. They are available for use by any department or division of the University for research or instructional work.

The Drug Plant Experiment Station, located at Lisle, Illinois, provides a unique opportunity for the development of drug plant research.

LIBRARY OF MEDICAL SCIENCES

The library contains a comprehensive collection of standard and modern works in subject fields of interest to dentistry, medicine, nursing, pharmacy, and social work students. Some 2,200 periodicals are being received regularly, and the library's resources include more than 190,000 volumes. Its facilities

are available for reference use, and most materials may be withdrawn for use outside the reading rooms.

MUSEUMS

The College of Dentistry has a museum for the study and demonstration of the ecology of the masticatory structures, containing over 1,000 specimens.

The College of Medicine has two museums: the Anatomy Museum, including exhibits relating to gross anatomy, histology, embryology, and neurology; and the Pathology Museum, including gross specimens for purposes of instruction of undergraduate and postgraduate students of medicine and dentistry.

The College of Pharmacy has a museum including more than 10,000 specimens of crude drugs and technical products. One collection is classified according to botanical origin and is arranged in cases illustrating habitat, commerce, etc. Another collection contains every drug officially listed in the United States Pharmacopoeia since 1820 and in the National Formulary since 1888.

RECREATIONAL FACILITIES

The Chicago Illini Union is the focal point for out-of-classroom life on the Medical Center Campus. Located adjacent to the residence halls complex, the Union plays an important role in the daily life of resident students and the campus life of commuting students, faculty, staff members, alumni, and guests of the University. Union facilities include: lounges, with a Music Lounge and Art Lounge; food service facilities, with a Cafeteria, Snack Bar, and Buffet Dining Room; conference rooms; a large multipurpose room; student activity offices; the University bookstore; a television room; and recreational facilities, including a Billiard Room, Game Room, and bowling lanes.

A variety of recreational and cultural programs and social events are sponsored by the student officers and committee chairmen, who form the Union Directorate with counsel from a student-faculty Union Board. Through its facilities, services, and programs, the Chicago Illini Union encourages interdisciplinary understanding and provides a stimulus for student participation in the creative process which is so essential to the training of those in the health sciences.

An intramural sports program is conducted under a trained director. Gymnasium facilities are available on the campus at 715 South Wood Street for indoor sports. Tennis courts are located nearby. Through special arrangements, the swimming pool and handball courts of the Duncan Y.M.C.A. are available to male students.

HOUSING

The University offers comfortable and convenient living quarters on the campus at reasonable rates in its Student Residence Hall, Women's Residence



Hall, and Staff Apartment Building. Faculty, nonacademic staff, residents, and interns, who are employed by the University at least on a half-time basis, are given priority in the assignment of apartments, but married students, graduate students, and others are also eligible on a space-available basis. If a married student's wife or husband is employed by the University at least on a half-time basis, the couple is eligible for employee priority on the waiting list. Assignments to the residence halls are based upon the date of application and policies established by the University Committee on Housing. Single, undergraduate women under twenty-one years of age as of September 1 of the current academic year who do not live with parents, relatives, or guardians must live in University-approved housing unless special permission to live elsewhere has been granted in writing by the Dean of Women. Other students are not required to live in University-owned units.

The Student Residence Hall accommodates 412 persons in 196 double, thirteen single, and seven rooms for resident advisers. Facilities include a central shower and washroom on each floor, laundry and pressing rooms, recreation room, a lounge-television room, baggage storage area, and automatic elevators.

The Women's Residence Hall is an air-conditioned building housing 177 persons. It contains eighty-seven double rooms and three resident adviser rooms. A number of the facilities are similar to those of the Student Residence Hall, including a central shower and washroom on each floor, laundry and pressing rooms, baggage storage, and an automatic elevator. In addition, the Women's Residence Hall features a study lounge on each floor, provisions for students to obtain private telephone service on an optional basis, contemporary furnishings, and a landscaped courtyard.

Meals are served three times per day in the air-conditioned Student Residence Hall Dining Room to residents of both the Women's Residence Hall and Student Residence Hall. Both residence halls are interconnected with the new Chicago Illini Union, thereby giving residents ready access to the many lounges, meeting rooms, programs, recreational facilities, and other services provided by the Union.

A staff of resident advisers is available to assist residents with personal problems and to see that a proper environment is maintained for study and living conditions. A student government organization promotes and maintains an effective program of self-government and social-recreational activities.

Contracts for accommodations in the residence halls are issued for the entire academic year. Payments may be made in full at the beginning of the academic year, quarterly, or by monthly installments in advance. The contract is for room and board and includes twenty meals per week. Application forms and additional information on housing may be obtained from the Housing Office, University of Illinois at the Medical Center, 818 South Wol-



cott Avenue, Chicago (mailing address: P.O. Box 6998, Chicago, Illinois 60680).

SPECIAL EDUCATIONAL OPPORTUNITIES

Traveling Scholar Program

The University of Illinois is one of eleven midwestern member universities of the Committee on Institutional Cooperation and a participant in the Committee's Traveling Scholar Program. This program enables an advanced graduate student to work at another campus for a semester in order to take advantage of special course offerings or research facilities, such as a unique laboratory or library collection, not available at his own institution. A CIC Traveling Scholar registers at his home university, and credit for the work is recorded there. Appointment as a Traveling Scholar is based upon the individual submission to the Graduate College of an application which carries the strong endorsement of the student's major department and the approval of the host institution. Each university retains the right to accept or reject any student desiring to study under its auspices. A student interested in participating in the program should consult with the head of his major department. Cooperation in this program is maintained especially with the University of Chicago and Northwestern University.

OBJECTIVES AND STANDARDS

Graduate education is predominantly an intellectual adventure and has as its chief objective the encouragement of advanced intellectual achievement in the form of productive scholarship and research.

Graduate training is not a matter of successfully completing a number of advanced courses but emphasizes chiefly original laboratory or basic investigation. A major requirement for both the Master of Science and Doctor of Philosophy degrees is a thesis based in a research problem. Students must devote at least one-half of their time to the thesis. Degrees are granted to students (1) whose level of scholarship and investigative endeavor proves that they have mastered a definite field of knowledge and recognize its potentialities and opportunities for further advances (2) who are able to integrate this knowledge with related domains of fact and understanding, and (3) who have proved themselves as independent and original scholarly investigators. The program, which is primarily one of training for research and teaching in the medical sciences, is entirely distinct from postgraduate training in the medical specialties.

High standards of admission are maintained, and careful selection and individual approval of faculty members is made to supply qualified advisers to graduate students. Laboratory, clinical, and library facilities are superior. Rigid tests in courses and examinations showing evidence of ability for pro-

ductive research are requirements for normal progress toward a graduate degree.

ADMISSION

General Requirements

It is recommended that prospective students apply for admission several months before the beginning of the term in which they expect to enroll. Applications for admission or readmission, including all necessary credentials, must be submitted by domestic students at least two weeks prior to registration or by foreign students at least six weeks prior to registration. A \$15 nonrefundable application fee must accompany the application. Deadline for fall quarter admission is August 31.

A nonrefundable deposit of \$30 on tuition and fees is required of all new and readmitted domestic graduate students. This deposit should not be sent until required by the University. Graduate students assured of the award of a fellowship, assistantship, or tuition and fee waiver are permitted to confirm their intention to enroll without payment of the advance deposit.

Admission forms may be obtained from the department in which the student wishes to pursue an advanced degree.

An applicant is favorably considered for admission to the Graduate College if (1) he is a graduate of an institution awarding a baccalaureate degree comparable to that granted by the University of Illinois; (2) he is adequately prepared for advanced study as demonstrated by his previous program of study and his scholastic record; and (3) he is recommended for admission by his major department and the Dean of the Graduate College.

The prerequisites for advanced work in the various fields of specialization are listed in the departmental sections of this catalog.

A department's recommendation with respect to the admission of an applicant is not based solely on the scholastic average. Therefore, not all who meet the scholastic requirements can be admitted.

Specific Requirements

Graduates of liberal arts colleges with majors in chemistry or biology, and one year of college physics, who rank in the top half of their graduating class usually meet admission requirements. Knowledge of one foreign language is recommended. It is possible to make up certain course deficiencies after admission for graduate work. Students with good academic records (B average) may be admitted directly without further examination. Others may be required to take departmental and Graduate Record Examinations. Three letters of recommendation, official transcripts, and the submission of completed application forms are necessary for final consideration.

A Bachelor of Science degree in pharmacy or nursing is required in some

disciplines, and the M.D. or D.D.S. degree may be a prerequisite for some areas.

Superior students pursuing a medical, dental, or pharmacy curriculum may be accepted on a highly selective basis for concurrent registration.

Applicants should demonstrate a desire for graduate training in the basic health related sciences and should expect to make teaching and/or research in one of these branches a lifetime endeavor.

Each applicant must submit with his application for admission an official transcript of his college record and letters of recommendation from those who are acquainted with his previous academic record. In order to qualify for admission, an applicant must have a scholastic average of at least 3.5¹ or its equivalent in his undergraduate work. For medical or dental graduates the average is based on both the preprofessional and professional record. After evaluation of all credentials, acceptance is recommended by the head of the department to the Dean, and the student is notified by the Graduate College. Registration is dependent on passing a mental and physical examination conducted by the University Health Service. Admission may be on probationary status. A student originally admitted on probation may be admitted to full status upon completion of the equivalent of a full quarter of satisfactory work (sixteen quarter hours of A or B) in formal courses.

Before final admission is granted to applicants whose scholastic average is less than 3.75, they must take the Graduate Record Examination consisting of the aptitude test and the advanced test in either biology or chemistry. These tests are administered at numerous centers throughout the country several times each year. To secure application forms and information concerning the time and place of the next examination, write to the Educational Testing Service, Princeton, New Jersey. Students who are currently pursuing the dental or medical curriculum or those who already have attained the Doctor of Dental Surgery or Doctor of Medicine degree are not required to take these tests. Provisional acceptance pending completion of the examination may be arranged with the Dean for those applicants who have suitable undergraduate records.

Applicants must complete the following procedure by August 31 for fall quarter applicants and forward data to the Office of Admissions and Records, University of Illinois at the Medical Center, P.O. Box 6998, Chicago, Illinois 60680:

1. Forward completed application forms to the Office of Admissions and Records.
2. Direct all institutions where academic work has been pursued to forward an official transcript to the Office of Admissions and Records.

¹ Average halfway between B and C. Transcripts from institutions using a different grading scale are evaluated by the Director of Admissions and Records in terms of the University of Illinois System. Averages are computed on the following basis: A=5; B=4; C=3; D=2; E (failure) =1.

3. Request three instructors closely associated with the applicant's field of interest to write letters of recommendation to the department.
4. Make arrangements to take the Graduate Record Examination and have the results forwarded (those with less than 3.75 undergraduate average) to the Office of Admissions and Records.

It is also desirable to arrange for a personal interview, and in certain instances it may be required.

Each applicant who is tentatively accepted should arrange with the University Health Service on this campus for a physical examination as promptly as possible. It is strongly urged that each applicant visit his own dentist and physician before registration, especially for (1) any needed dental work, (2) refraction and fitting of glasses if needed, (3) vaccination against small-pox, (4) typhoid immunization, (5) tetanus immunization, (6) diphtheria immunization or a booster, and (7) a chest X-ray. A Mantoux test for tuberculosis is also advisable. After registration the student will find it difficult to have these essential things done without loss of time from study.

The University Health Service offers emergency medical care to all students. All students participate in the University of Illinois hospital and medical service insurance program.

Foreign Applicants

A student from abroad who wishes to be admitted to graduate study should enclose with his initial inquiry for admission copies of his complete academic records which have been officially certified by the educational institutions he has previously attended. These official records should include a listing of all final degrees, diplomas, or certificates awarded.

An authenticated English translation must accompany all documents that are in a language other than English.

Prospective applicants must also provide the following information: full legal name; address to which reply should be mailed; place and date of birth; name of the country of which he is now a citizen; marital status; form of permanent physical handicap, if any; the subject in which he wishes to specialize; native language; whether he wishes to be a candidate for an undergraduate or graduate degree; amount in United States dollars available for support, the source of income, and the length of time this support is guaranteed; a complete chronological list of all elementary and secondary schools and colleges attended, with the exact dates of attendance, and diplomas, certificates, or degrees received; if he is not attending school, his occupation since leaving school; the date he plans to enter.

Because it is not advisable to undertake a graduate program without adequate competence in the English language, all applicants whose native tongue is not English are required to take an English proficiency test. De-

tails and instructions regarding the test are sent to the applicant after it has been determined that he is otherwise eligible for admission. Upon receipt of satisfactory English test results and the completed application form, documents admitting the student to the Graduate College, including an appropriate certificate to apply for a visa to enter the United States, will be issued.

REGISTRATION AND PROGRAM OF STUDIES

Registration. Graduate students must register at the beginning of each quarter. Initial registration is permitted only after a student's application has been approved and he has been notified by the Graduate College.

Upon acceptance, a student obtains registration forms and instructions in the Graduate College office and is assigned the major adviser, with whom he discusses his program of study and research. After obtaining the signature of the major adviser, the student obtains the signature of the instructor for each course. The registration forms are then submitted to the Dean of the Graduate College for approval. Admission to graduate courses is granted only to persons who have the requisite undergraduate work.

Registration, including the payment of fees, must be completed before the close of the regular scheduled day for this purpose.

Change of Program and Withdrawal. A graduate student is expected to plan his work carefully. When a change seems advisable, it may be permitted if approved by the major adviser, the instructors involved, and by the Dean of the Graduate College. Simply ceasing to attend class does not constitute official withdrawal. If a student wishes to drop a course or to add other work, he must first secure an official change slip from the office of the Graduate College. Changes in program are permitted. A student is not permitted to drop a course after the term is half finished if his grade in that course is C or below, unless he is willing to accept a grade of E therein. Exceptions may be made by the Dean when justified.

A student who wishes to withdraw from the University must obtain a clearance form at the office of the Graduate College.

Change in Major Subject. A student who wishes to transfer from one department to another must secure and present to the Dean the written approval of his present major department.

Credit for Courses. Courses numbered from 300 to 399 are open to advanced undergraduate and graduate students, and those numbered 400 and above are open to graduate students only. Courses numbered below 300 do not carry graduate credit.

Graduate credit is measured in terms of quarter hours. The maximum program for a full-time graduate student is sixteen quarter hours each quarter.

Courses Taken at Other Institutions. Students desiring to register for a course at another institution may do so only with the approval of the major adviser and the Dean of the Graduate College prior to registration for the course. When the course is completed, the appropriate amount of credit is accepted and recorded upon receipt of a transcript. The CIC (Committee on Institutional Cooperation) agreement enables graduate students to cross institutional lines for short-term work at neighboring Northwestern University and the University of Chicago without charge. Students may also register concurrently at the Chicago Circle Campus of the University of Illinois.

Graduate Study by Medical Students. Upon acceptance for the first year in medicine, a student who has a bachelor's degree may, with the approval of the Dean of the College of Medicine, be permitted to register for four quarter hours of graduate work each quarter concurrently with a full program of medical courses and for a full program of graduate work in a free summer quarter. Medical students who have not completed a bachelor's degree but who maintain a B average in their first year in the College of Medicine are also extended these privileges. Registration may continue in the following quarters as long as a good record is maintained in the medical curriculum.

Medical students who take advantage of this opportunity become familiar with the methods of research and advanced study and are granted credit by specialty boards for the basic science time credit requirement. Courses credited toward a professional degree can not be used for duplicate formal credit toward a graduate degree; however, recognition is given to the extensive program of basic science courses pursued in the medical curriculum, and a lesser program of formal graduate courses is accepted for the M.S. and Ph.D. degrees (see details under degree requirements).

Combined M.D.-Ph.D. Program. Medical students who wish to register for a simultaneous M.D.-Ph.D. degree program should submit a program of study for approval by the Dean, noting the work to be taken in each quarter. In the case of assistants, the percentage time of employment should be noted in those quarters when service is to be rendered to the department. The combined program may be completed in six years.

Graduate Study by College Seniors. A college senior who has been in residence for at least three quarters and who is within five semester hours of his bachelor's degree may be admitted to the Graduate College if his grade-point average for the last 50 per cent of the hours completed is approximately 4.0. Seniors who meet these requirements and who wish to apply should submit an application for admission together with a letter from the Dean of the undergraduate college specifying the hours needed to secure the bachelor's degree. If admitted to the Graduate College, the student carries as miscellaneous course work the hours needed to complete the requirements for the

first degree; in addition, he registers for courses to be credited toward an advanced degree.

A senior in the College of Pharmacy (fifth year) may register for four quarter hours of graduate courses for graduate credit if his grade-point average is 4.0 and if he secures the approval of the head of the major department and the instructors concerned.

Graduate Study by Academic or Nonacademic Members of the Staff. Employees whose departmental head or director requests that they take a course to improve their potential services to the University may register for those courses as auditors without formal credit toward a degree. Assistants, research assistants, residents, interns, and others on the University staff who undertake graduate study can not expect to complete requirements for a degree as promptly as those who devote full time to their academic work. The academic programs of assistants and others on the University staff are limited by statute, and exceptions are permitted only occasionally for advanced students who can show compelling reasons for such deviation. Those employed outside the University are expected to reduce their programs of academic work in accordance with these regulations. The maximum amount of work allowable is determined in accordance with the terms of employment as follows:

Full-time employment.....	4 quarter hours
Three-quarter time employment.....	8 quarter hours
One-half time employment.....	12 quarter hours
One-quarter time employment.....	16 quarter hours

Individuals on the academic staff are not admitted as candidates for an advanced degree if they hold an appointment as Professor, Associate Professor, Assistant Professor, or Research Associate in any department or division of the University. Any person engaged in graduate study who accepts an appointment with the rank of Research Associate or higher is dropped as a degree candidate.

Graduate Study in the Summer. A full quarter term of work is available during the summer. Medical, dental, and pharmacy students may register for 16 quarter hours during the summer, provided they have the quarter free for full-time graduate study.

Time Limit for Completion of Degree. A candidate for the master's degree must complete all requirements for the degree within five calendar years after his first registration in the Graduate College, and a candidate for the doctor's degree within seven years after his first registration in the Graduate College, except as noted in the next paragraph.

A candidate for the doctorate who has received a master's degree elsewhere must complete all requirements for the degree within five years after

his first registration in the Graduate College. A student whose program of study is significantly interrupted after he receives a master's degree from the University of Illinois and who later returns to work for his doctorate will have five years from the date he returns to complete degree requirements.

Not more than the minimum number of hours (48) required for the master's degree may be applied to the total required for the doctorate (144 quarter hours) at the time of approval of the doctorate program without prior approval of the Dean.

Grades. Grades are recorded as follows: A, B, C, D, and E. A grade of E indicates a failure, and a grade of C or D indicates unsatisfactory, though passing, work. A student at the Master of Science level may receive five quarter hours of grade below B without penalty, but if he receives additional hours below B he must replace all of them with A or B grades, in equivalent course work. A student is automatically placed on probationary status when he has acquired ten quarter hours below a B grade. Such status appears on his transcript of record. Sixteen quarter hours of a grade below B disqualify a student for further work at the Master of Science level. In pursuit of formal courses toward the Ph.D. degree, a grade of C is validated for credit and formal course requirements by a grade of A in a formal course of equivalent credit. Sixteen quarter hours of uncompensated grades disqualifies a student for further registration.

A failure or absence from an examination in any course in the major field precludes the conferring of the degree in the year in which the failure occurred.

Attendance at Commencement. Candidates for graduate degrees are expected to attend Commencement exercises in June.

Petitions. The normal procedures and requirements of the Graduate College are indicated in this catalog, but these may be modified occasionally for justifiable reasons. A student may petition the Dean and the Executive Committee of the Graduate College for exceptions, but he should do so only after consultation with his adviser.

Advisers. Every graduate student must have an adviser. The adviser's primary duty is to assist the student in planning and carrying through a program of graduate work which fits the needs and desires of the student, and at the same time satisfies departmental and Graduate College requirements. A new graduate student should go to his major department to discuss the selection of an adviser.

Transfer of Credit. A graduate student who has completed graduate courses elsewhere may petition for transfer of credit. Such a transfer must not exceed sixteen quarter hours of work and must have the recommendation of the head of the department in which the student is pursuing his program

and the approval of the Dean. In such instances the department must be satisfied that the work is equivalent to the level of graduate courses offered by the University of Illinois. The petition is not considered until the general residence requirement of three quarters is fulfilled.

THE DEGREE OF MASTER OF SCIENCE

The program for the Master of Science degree permits the superior student to explore intimately the subject matter of his major area of specialization and provides him with an opportunity to develop research competence. The Master of Science degree may be terminal, or the course of study and research may be designed to serve as the foundation for a more advanced scholarly undertaking leading to the Ph.D. degree. The Master of Science program should involve a program of research culminating in a satisfactory thesis.

Study Program — Minimal Formal Requirements for the M.S. Degree

Laboratory research.....	10 quarter hours
Formal courses (5 quarter hours in 400 series required)	16 quarter hours
Seminars and electives.....	22 quarter hours
An acceptable thesis	
Sustain an oral examination	

Sixteen quarter hours constitute a normal quarter program. Forty-eight quarter hours must be completed for the degree. At least 24 quarter hours of the total must be in the major discipline.

Medical students or medical graduates will be required to absolve only five quarter hours of 400 series formal courses (since they have completed or will have completed 96 quarter hours of basic science formal graduate courses in the 300 series in their medical curriculum). A minimal program for these students therefore could be five quarter hours of 400 series formal courses and 43 quarter hours of research and seminar courses.

Residence. Each degree candidate must spend a certain period of time in “residence.” Residence is realized when a student lives in the community, or its immediate surroundings, and devotes an appreciable portion of his time to graduate studies on the campus. A student who is regularly employed on a full-time basis outside the community is not considered to be in residence even though he is registered in a campus course.

The time required to complete residence requirements and to attain the Master of Science degree is referred to as the “first year” of graduate study.

Foreign Language. A foreign language is not required for the Master of Science degree, but students contemplating work for the doctor’s degree should make arrangements to satisfy the foreign language requirements of the department in which they are registered (see departmental programs).

Thesis. A candidate for a master's degree must submit a thesis on a subject approved by the professor in charge of his major work. Such approval must be secured, and the subject of the thesis filed at the office of the Graduate College, not later than the beginning of the last quarter of residence, at which time a thesis advisory committee will be appointed.

Thesis Work in Absentia. A student may be permitted to complete the last ten quarter hours of his work, if devoted to his thesis, under leave of absence. To receive such permission, the student must have accumulated at least 38 quarter hours in residence, must petition for the privilege, and must submit an outline of the proposed investigation approved by the head of his major department and satisfactory evidence that adequate facilities are available at the place where he intends to do the proposed work. If the petition is approved, the student must register, pay tuition fees, and discuss his progress with his major adviser at frequent intervals.

Thesis Preparation. Specific written instructions for the preparation and form of the thesis are available at the Graduate College office. Special thesis paper is required, and title pages and envelopes must be printed. Two copies of the approved thesis are required, one for the University Library at Urbana and the other for the Library of Medical Sciences at Chicago. The thesis may be submitted at any time during the year; however, candidates who expect to receive a degree in June must meet the deadline.

Oral Examination. Upon deposit of the thesis, a committee is appointed by the Dean to examine the thesis and to determine the candidate's knowledge in the major and minor fields of study. Degrees are conferred at the June Commencement. Candidates must be recommended to the Dean for the degrees indicated at least two weeks before the date set for the Commencement exercises.

Publication of the master's thesis is encouraged and does not require prior approval of the Graduate College.

Applications for Degrees. Each candidate for the degree of Master of Science must file an application for the degree on a blank provided for that purpose. For the dates of application and deposit of theses, consult the office of the Graduate College.

THE DEGREE OF DOCTOR OF PHILOSOPHY

Admission. Students desiring admission to graduate study beyond the Master of Science degree must file an application with the department of choice. Students who have completed the Master of Science degree or those who have completed satisfactorily 48 quarter hours of graduate study and desire to pursue a formal program toward the Ph.D. degree shall indicate this desire to the major adviser. Previous to registration of the student for work toward the Ph.D. degree, a committee composed of the student's major adviser

as chairman and two additional members of the graduate faculty, chosen by the major adviser or the department head, will arrange an interview with the student and outline a program of formal courses, seminars, foreign language examinations, and other requirements in an integrated whole relevant to the objectives of the student and his major adviser; the program as outlined shall be recorded in the Graduate College and is subject to alteration at the discretion of the departmental committee. A student who petitions to by-pass the M.S. degree must have met the departmental requirement for foreign languages and must be in good standing in the Graduate College.

Transfer Students with Degree of Master of Science. Upon the recommendation of the head of the department of the major field of study and with the approval of the Dean of the Graduate College, admission with advanced standing is granted to applicants who have completed a master's degree or the equivalent elsewhere and who desire to become candidates for the doctor's degree at the University of Illinois. If the applicant is admitted, his year of advanced study completed elsewhere is accepted as one year of residence, and the amount of credit to be accumulated at the University of Illinois shall be determined by the committee for the qualifying interview. In any case it shall not be less than 96 quarter hours.

Study Program — Minimum Formal Requirements for the Ph.D. Degree

Formal 400 series courses	16 quarter hours
(Ten quarter hours must be in the area of the major discipline, and six quarter hours must be in the area not directly related to the major discipline.)	
Research, seminars, and elective formal courses	128 quarter hours
Sustain the oral preliminary and final examinations	
An acceptable thesis	

Formal courses completed in the M.S. program may partially satisfy the requirements for the Ph.D. degree. More than 50 quarter hours of formal courses will be allowed only by petition.

For those basic medical science departments where the departmental requirements make it mandatory for the student to pursue 16 quarter hours or more of 300 series courses as prerequisites for more advanced work, any credit earned in excess of 16 quarter hours in 300 series in medical basic science courses may be counted as 400 series courses up to a maximum of five quarter hours, provided the excess credit is in an area outside the major discipline. A minimum of ten quarter hours of 400 series formal courses originally approved as such and listed as 400 series formal courses must be absolved by every candidate for the Ph.D. degree, and five quarter hours of 400 series formal courses must be completed for the Master of Science degree.

The program for the Ph.D. degree does not require a formal minor but substitutes for it formal course work in an area not directly related to the major discipline. A student may, at his option, declare a formal minor and absolve the usual requirements of 20 quarter hours, ten hours of which must be in formal course work. A split minor is not allowed. The minor must be selected in a discipline which has an approved curriculum leading to the Master of Science degree.

Registration in Basic Medical Science Courses. Upon recommendation of the major adviser to the Dean, a student may pursue, without credit, basic science courses not specifically required in the Doctor of Philosophy program. Grades obtained in such courses are not prejudicial to the student's standing in the Graduate College. It is obvious, however, that unsatisfactory grades may be detrimental to his general progress and standing in the area of his major and minor departments as determined by those departments.

The privilege of registering for additional basic science courses as stated above is curtailed if it appears that the student's intent is to meet the requirements of the medical curriculum thereby. Registration is not allowed for more than one such course each quarter on this basis.

Foreign Language Requirements. The Graduate College does not have a foreign language requirement. However, several of the departments have such requirements. Students should make arrangements to satisfy foreign language requirements of their department (see departmental programs).

Period of Study. The minimum period of study required for the degree of Doctor of Philosophy is two years beyond the master's degree, during which the student is required to devote all of his working time to his studies. Both years must be spent in residence at some accredited educational institution. If the student has obtained his Master of Science degree at the University of Illinois and obtains the approval of the Executive Committee, one of the two years may be spent in absentia. A student who has completed the first year of graduate work elsewhere must be in residence during the two remaining years. In exceptional cases, a student with two years of graduate study elsewhere who satisfies his major department that he has completed work equivalent to the standard departmental requirements is permitted to take his preliminary examination, provided he has fulfilled the language requirements. If such a student passes the preliminary examination, he may complete the requirements for the Doctor of Philosophy degree by devoting the third year to research in residence. The degree is conferred, however, not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by a thesis and examination.

Residence Requirements. A student pursuing a Ph.D. degree is in residence only when registered in the Graduate College and spending full time

on the campus. Such a student earns one quarter of residence if he is registered for ten or more quarter hours.

Continuous Registration. A candidate for the Doctor of Philosophy degree who has passed the preliminary examination, has fulfilled all formal course requirements, and has attained a total of at least 144 quarter hours is nevertheless required to continue his registration in the Graduate College until he has passed the final examination. Students may register for zero credit in Thesis Research 499 during their last quarter whether on the campus or in residence elsewhere in order to maintain their status as a degree candidate.

Preliminary Examinations. A candidate for the Doctor of Philosophy degree must pass a preliminary examination intended to test his knowledge of his major and related fields of study and to determine whether he is prepared for the final year of work. He is eligible to take the examination when (1) he has completed a Master of Science degree or has approval to bypass this degree; (2) he has satisfied the language requirements; (3) he has satisfactorily completed 48 quarter hours work beyond the master's degree or a total of 96 quarter hours work and all of the nonresearch courses prescribed by the qualifying committee; and (4) his adviser informs the Dean that the candidate is adequately prepared.

The examination extends to the candidate's whole field of study. It is not confined to specific courses taken in this or other universities, but is conducted to determine whether the candidate has mastered a definite field of knowledge and is able to evaluate its potentialities and opportunities for further advances. The student must also satisfy the committee that he is able to integrate his field of specialization with the larger domains of knowledge and understanding. The examination is partly oral, and may be wholly so.

The student must complete two full quarters of residence between his preliminary examination and the completion of his work for the doctorate.

Other Examinations. Before the candidate is admitted to the final examination and defense of his thesis, he may be required to take any other examination, oral or written, which is thought proper by the various departments in which he has studied.

The above examinations are in addition to those in the courses for which the student is registered, and must be taken at the time set by the major adviser.

Final Examination. At least three weeks before the time when the degree is conferred, the candidate must submit to a final examination given by a committee appointed by the Dean. This examination is primarily on the research work of the student as embodied in his thesis and is conducted chiefly to determine if the candidate has demonstrated the capacity to do

original and independent scholarly investigations in the field of his choice, but is not confined to that alone. It is intended to verify also that the candidate has a satisfactory grasp of his major subject as well as an acquaintance with the field of knowledge pertaining less directly to it.

A department may elect to forego the customary final Ph.D. examination and substitute in its place an open departmental seminar at which one or more candidates will present the results of their investigations together with related scholarly material. In addition to the members of the thesis committee who attend, faculty from other departments, graduate students, and other interested parties may attend. While the seminar will take the nature of a ceremonial event rather than an examination in the usual sense, the candidates may be expected to withstand critical interrogation by members of the thesis committee or others present.

Thesis. The ability for independent research must be shown by the production of an original thesis on some topic connected with the major field of study. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it in connection with his final examination.

The subject of the thesis should be chosen and the title submitted to the Graduate College office not later than the first registration following successful completion of the preliminary examination, at which time a thesis advisory committee is appointed.

Not later than two weeks prior to the final examination, and not less than five weeks before the time when the degree is to be conferred, two type-written copies of the complete thesis and an abstract on thesis paper and in final form with title pages, envelopes, and certificates of approval must be deposited in the office of the Graduate College. The style and form of the thesis and abstract must comply with the written instructions obtainable at the Graduate College office. After the thesis is checked in the Graduate College office, the student must arrange for each member of his doctoral committee to read the thesis before the date of the final examination.

Certificates. Each of the copies of the thesis must be accompanied by a certificate of approval. The certificate forms are available in the Graduate College office and must be signed by the person under whose immediate supervision the thesis was prepared and also by the head of the major department. In considering the deadline for submitting the thesis and abstract to the Graduate College in its final form, the adviser and the student should allow the head of the department sufficient time to review both the abstract and the thesis before affixing his signature of approval to the certificates. These certificates must also be signed by the members of the examining committee immediately following the oral examination.

Microfilm Reproduction. In order to insure that theses are available for use by others, they must be microfilmed. Each candidate who passes the final examination must pay a fee of \$25.00 and deposit a typewritten abstract of his thesis of approximately six hundred words, together with the original and first carbon of the complete thesis. This fee provides for (1) microfilming of the complete dissertation, with one copy deposited in the University of Illinois Library, (2) publication of an abstract of six hundred words or less in Dissertation Abstracts.

The abstract must indicate the method followed, the evidence used, and the conclusions reached in the investigation, and must follow the form generally used for publication of abstracts.

Publication of Thesis. Formal publication of the thesis, either in its entirety or in a condensed form, it is not required. However, students should consider the advantages to them, and to their professional field, of publication of the significant methods and findings of their research in the technical literature. If published, the article or book should have a note indicating that the material is, or is based upon, a dissertation submitted in partial fulfillment of the requirements for the Doctor of Philosophy or Master of Science degree at the University of Illinois.

Application for Degree. Each candidate for the Doctor of Philosophy degree must file an application for the degree on a blank provided for that purpose. Application is made at the time the thesis is submitted in final form to the Dean. Degrees are conferred in June.

FINANCIAL ASSISTANCE

Various types of financial assistance are available each year to promising graduate students in any field in which the Graduate College offers an advanced degree. Detailed information about the qualifications and application procedures for these awards is obtained by writing to the graduate department.

The principal kinds of awards are:

University Fellowships. University Fellowships are awarded on the basis of an all-University competition and are unrestricted as to the student's field of graduate study. Each provides a stipend of not less than \$2,900 for twelve months with exemption from tuition and fees. University Fellows must carry a full program, 16 quarter hours or the equivalent.

Merit Award Teaching Fellowships. These appointments provide a tax-free fellowship stipend plus a taxable salary for service as a half-time teaching assistant, with the usual exemption from tuition and incidental fees. Recipients are required to take certain courses to improve their teaching methodology.

Industrial, Endowed, and Special Fellowships, and Traineeships. Various industrial firms, foundations, government agencies, and private individuals have generously donated funds to support a number of special fellowships and traineeships for graduate students at the University of Illinois. The stipends and supplemental allowances of these fellowships are not uniform, and most of them are restricted to students in particular areas of study.

National Science Foundation and U. S. Public Health Service Graduate Fellowships. These fellowships are funded from federal sources of funds but are administered with the cooperation of the participating universities, including the University of Illinois. They are restricted to United States citizens who are graduate students in the mathematical, physical, medical, biological, and engineering sciences and in certain other fields regarded as employing scientific methods. Each carries a beginning stipend of \$2,400 for twelve months and provides for tuition and fee exemption and allows \$500 for each dependent.

U. S. Public Health Service Traineeships. Under this program, grants are made directly to the participating institutions, who select a specific number of promising individuals for full-time graduate study. Appointments may be made only to citizens of the United States (or native residents of a United States possession) who are enrolled in programs leading to an advanced degree in the physical, medical, and biological sciences. Also included are interdisciplinary areas which are comprised of overlapping fields among two or more sciences (for example, neuropharmacology).

The basic stipends for twelve months are \$2,400 for those at first-year level, \$2,600 for those at intermediate-year level, and \$2,800 for those at terminal-year level, plus exemption from tuition, service fee, and hospital-medical-surgical insurance fee. An allowance of \$500 is sometimes granted for each dependent. Recipients of these awards may elect a nine months' tenure, rather than twelve months, with a corresponding decrease in the stipends and allowances.

Inquiries concerning traineeships should be directed to the appropriate department at the University.

A recipient of a predoctoral fellowship or traineeship must register in the Graduate College and must pursue a program of academic study and research leading to a graduate degree. Stipends paid to the individual are not for definite services performed for the University, but are to provide living expenses while the approved course of study or research is being pursued. Fellows must devote full time to such activities, and only limited teaching, proctoring, grading of papers, or other routine duties are required of them as an educational experience.

Fellows are selected by the Fellowship Committee on the basis of scholarship and promise in teaching or research as revealed by transcripts, letters

of reference, and recommendations by the major departments. Successful applicants will receive a notice of appointment on or before April 1 and are expected to accept or decline by April 15. At the time an award is accepted, the Fellow agrees that he will neither engage in any outside employment for remuneration nor hold concurrently any other fellowship carrying a stipend.

Fellows are eligible for reappointment in competition with new applicants. Fellowships provide an opportunity for research training in the basic sciences, or in the application of these sciences to clinical investigation. They are intended primarily for graduates who are in the early stages of their preparation for a teaching and research career. Fellowships are not intended to provide stipends for those fulfilling professional specialty board requirements or for those pursuing advanced work of a professional character.

Application forms may be obtained from the departments conducting graduate programs and must be submitted by March 15 for appointments which become effective on the following September 1.

Attention of all graduate students is directed to fellowship support offered by federal agencies such as the National Institutes of Health, Bethesda, Maryland, and the National Science Foundation, Washington, D.C. A student should apply directly to those agencies and may obtain approval to conduct his work at the University of Illinois if accepted as a graduate student.

A number of summer fellowships are available for professional or graduate students who begin graduate programs in the summer. Stipends of \$600 are awarded to a limited number of applicants on a competitive basis. Special part-time fellowships for medical students are available at \$200 per quarter on a competitive basis for those who carry a full-time professional curriculum and who qualify for research work under the direction of a faculty adviser during their free time.

SCHOLARSHIPS

Acts of the General Assembly of Illinois provide scholarships for veterans of World War I and World War II who are not receiving financial assistance for educational purposes from the federal government and who, at the time of enlistment, were residents of Illinois or students at the University of Illinois. These scholarships exempt the holders from the tuition fees in any department of the University. The General Assembly also has established one scholarship in each county for descendants of veterans of World War I and one scholarship for descendants of veterans of World War II. These scholarships are awarded by competitive examination held on the first Saturday in April.

ASSISTANTSHIPS

A number of departments offer half-time assistantships at \$2,900 for the academic year. Assistants are required to perform services for the University

such as grading papers, proctoring, and assisting in laboratory teaching. Half-time research assistantships are also available for twelve months.

Assistants must carry a reduced study schedule as indicated on page 21 of this catalog, but the greater length of time required to complete the degree is compensated for by the additional gain in teaching and research experience. Tuition waivers are available for part-time assistants whose appointments require at least 25 per cent but no more than 67 per cent time.

The University of Illinois adheres to the following resolution adopted by the members of the Association of American Universities and a number of other graduate schools of North America:

“In every case in which a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or a prospective graduate student, the student, if he indicates his acceptance before April 15, will still have complete freedom through April 15 to reconsider his acceptance and to accept another fellowship, scholarship, or graduate assistantship. He has committed himself, however, not to resign an appointment after this date unless he is formally released from it.”

LOAN FUNDS

Loan funds have been established for the benefit of worthy students in the University who need financial assistance. The University of Illinois also participates in the Student Loan Program under the National Defense Education Act. Application blanks for both types of loans may be secured from the Dean of Student Affairs.

FEES AND EXPENSES

Students registering for graduate work pay fees according to the following schedule:

	<i>Range I</i>		<i>Range II</i>		<i>Range III</i>	
	<i>Above 10</i>		<i>Above 5 to 10</i>		<i>Above 0 to 5</i>	
	<i>quarter hours</i>		<i>quarter hours</i>		<i>quarter hours</i>	
	<i>Non-</i>	<i>Non-</i>	<i>Non-</i>	<i>Non-</i>	<i>Non-</i>	<i>Non-</i>
<i>Graduate Fees</i>	<i>Resident</i>	<i>resident</i>	<i>Resident</i>	<i>resident</i>	<i>Resident</i>	<i>resident</i>
Tuition ¹	\$132	\$418	\$ 92	\$287	\$ 50	\$157
Service Fee ²	46	46	32	32	18	18
Hospital-Medical-Surgical Fee ³	7	7	7	7	7	7
Total	\$185	\$471	\$131	\$326	\$ 75	\$182

¹ Except those holding exemptions.
² Persons on the academic, administrative, or permanent nonacademic staff of the University for at least 25 per cent of full-time service and persons registered in absentia or off-campus are exempt from the Service Fee.
³ Students presenting evidence of equivalent coverage may receive a waiver of the Hospital-Medical-Surgical Insurance Fee upon approval of a petition submitted to the University Insurance Office not later than the final day established for full refund of fees. Persons registered for thesis research in absentia are not assessed the Hospital-Medical-Surgical Insurance Fee. STUDENTS MAY OBTAIN HOSPITAL-MEDICAL-SURGICAL INSURANCE FOR DEPENDENTS BY APPLYING TO THE BUSINESS OFFICE AND PAYING AN ADDITIONAL FEE.

SPECIAL FEES

Late Registration Fee	\$15
Former students who register after the regular registration days are subject to this fee.	
Special Examination Fee	\$10
This fee is charged for any special examination given in a course which has been failed.	
Transcript Fee	\$ 1
Each student who has paid all his University fees is entitled to receive, without charge, one transcript of his record. For each additional transcript the fee is \$1.	

ASSESSMENTS AND EXEMPTIONS

Assessments. For fee assessment purposes, a staff appointment must require service for not less than three-fourths of the term. This is interpreted as a minimum of three and one-half months in a semester, eight weeks in a quarter, and six weeks in an eight-week summer session. Staff tuition and fee privileges do not apply to students employed on an hourly basis in either an academic or nonacademic capacity, or to persons on leave without pay.

University employees appointed to established Civil Service positions whose rate of pay is determined by negotiation, prevailing rates, union affiliation, etc., are not considered as part of an hourly basis and are entitled to the same tuition and fee privileges accorded to other staff members under the regulations.

Any student who resigns his staff appointment, or whose appointment is cancelled before rendering service for at least three-fourths of the term, becomes subject to the full amount of the appropriate tuition and fees for that term unless he withdraws from his University classes at the same time the appointment becomes void. Such students are not assessed tuition and fees for that term if they file clearance for graduation within one week after the appointment becomes void.

Students holding academic appointments to the close of the final term of an academic year either as employees or fellows, and for whom tuition and/or fees have been provided through waiver or through cash payment by an outside agency, are entitled to a waiver of the same kinds of tuition and fees for the summer session immediately following, provided they hold no appointments during that summer session.

A nonrefundable deposit of \$30 on tuition and fees is required of all new and readmitted domestic graduate students. This deposit should not be sent until requested by the University. Graduate students assured of the award of a fellowship, assistantship, or tuition and fee waiver are permitted to confirm their intention to enroll without payment of the advance deposit.

Exemptions. A student may be exempted from one or more of the usual charges if he qualifies under the following conditions:

TUITION IS WAIVED FOR:

- (1) Holders of tuition waiver scholarships.
- (2) All academic employees of the University on appointment for at least 25 per cent but not more than 67 per cent of full-time services in an established position for a specific amount of time and salary commensurate with the percentage of time required.
- (3) All nonacademic employees of the University in an established permanent, and continuous position on appointment for at least 25 per cent of full time who register in University courses in Range II or III.
- (4) Holders of graduate tuition and fee waivers awarded by the Graduate College.
- (5) Residents in the University of Illinois Hospital (Medical and Dental).
- (6) Full time medical, dental, and pharmacy undergraduate students registered concurrently for part-time graduate study.
- (7) Persons registered in noncredit seminars only.
- (8) University employees registered at the request of their departments in non-credit courses especially established to improve the work of the employee.
- (9) Academic staff members emeriti.

SERVICE FEE IS WAIVED FOR:

- (1) All staff members of the University on appointment for at least 25 per cent of full time.
- (2) Holders of graduate tuition and fee waivers awarded by the Graduate College.
- (3) Students registered *in absentia*.
- (4) Students registered in courses taught off campus.
- (5) Residents serving in the University of Illinois Hospital (Medical and Dental).
- (6) Medical, dental, and pharmacy undergraduate students registered concurrently for part-time graduate study.
- (7) Persons registered in noncredit seminars only.
- (8) University employees registered at the request of their department in non-credit courses especially established to improve the work of the employee.
- (9) Academic staff members emeriti.

HOSPITAL-MEDICAL-SURGICAL INSURANCE FEE IS WAIVED FOR:

- (1) Students presenting evidence of equivalent coverage upon approval of a petition presented to the University Insurance Office not later than the final day established for full refund of fees.
- (2) Persons registered for thesis research *in absentia*.
- (3) Persons registered in noncredit seminars only.
- (4) University employees registered at the request of their departments in non-credit courses especially established to improve the work of the employee.

SERVICE CHARGE FOR DEFERRED FEES

Tuition and fees for each quarter may be paid in three installments, one-

third payable at registration, and one-third in each of the following two months. Students electing the installment plan for payment of tuition and fees are assessed a \$2 service charge.

NONACADEMIC EMPLOYEES

University employees in an established, permanent, and continuous non-academic position employed for at least 25 per cent of full time are exempt from payment of tuition and fees. The limitation of hours for which an employee may register is stated in another section of this catalog. Employees who register at the request of their department in noncredit courses to improve their capacity to serve the University pay no fees. A permit to register must be obtained from the Personnel Services Office.

FEES FOR MEDICAL, DENTAL, AND PHARMACY STUDENTS

Students registered concurrently for graduate study and full-time dental, medical, or pharmacy programs are exempt from graduate fees in the Graduate College.

FEES FOR PERSONS ON THE UNIVERSITY STAFF

Members of the academic staff of the University of Illinois may register in University courses without payment of the tuition fee and service fee, provided that their annual appointment specifies not more than 67 per cent time and not less than 25 per cent time service to the University.

Academic or nonacademic employees whose department head requests that they take a course to improve their potential for service to the University shall register for those courses as "auditors." Such registrants are fee exempt.

WITHDRAWAL (all colleges)

A student subject to tuition and/or fees who withdraws from the University during any term receives refunds as follows:

a. During the first ten days in the quarter, refund is made of the full amount of the tuition and fees assessed except for a nonrefundable charge of \$30.¹ When the total assessment has been less than \$30, the full amount of the assessment, if any, is nonrefundable.

b. After the first ten days but within the first half of the quarter, one-half of the total amount of the tuition and fees assessed which remains after deduction of the above mentioned amount is refunded.

c. After the midpoint of the quarter, no refund is allowed.

REDUCTION OF PROGRAM

A student who reduces his registration to a lower range receives a refund

¹ The nonrefundable charge includes the Hospital-Medical-Surgical Insurance Fee, if originally paid, and the student who withdraws from the University continues to be covered by the insurance until the close of the term. The remainder of the retained amount is allocated first to the Service Fee and then to tuition.

of the full amount of the difference in tuition and fees specified for such schedules provided the changes are made during the period designated for refund of full fees in case of withdrawal from the University. One-half the above difference is refunded if the changes are made during the period for one-half refund in case of withdrawal from the University. Thereafter, no rebate is allowed.

FIELDS OF INSTRUCTION LEADING TO MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY DEGREES

Anatomy

The goal of graduate training in anatomy is to develop research scholars who are prepared to engage in creative work in some field of morphological or experimental biology and to train competent teachers in the morphologically oriented sciences.

The fields of study open to a graduate student are functional and evolutionary morphology, cell structure and function, developmental biology, immunobiology, endocrinology, and neurobiology.

Preference for admission is given to those students who intend to complete a doctoral program. With approval, students may by-pass the master's degree and work directly toward a Ph.D. degree.

All entering graduate students are expected to complete Anatomy 301, 302, 303, and 421. Beyond these, a broad range of formal and seminar courses, representing specific fields of study, is offered in this department. Courses relevant to the student's area of research are also available in other departments. (Students in the Department of Anatomy may participate in special intra- and inter-university programs.) Students interested in functional and evolutionary morphology may utilize the facilities and take courses in the Center for Graduate Studies at the Field Museum of Natural History. Competence in one or two specific foreign languages may, at the discretion of the adviser, be required for an advanced degree.

Financial support, including tuition, fees, and allowances for dependents, is available. Application for financial support is made at the time of application for admission.

GRADUATE TEACHING FACULTY

Professors: ROBERT H. KREHBIEL, ARTHUR LAVELLE, EDITH K. MACRAE, HELEN C. MAIBENCO, JAMES C. PLAGGE, KEEN A. RAFFERTY, JR., ANTHONY J. SCHMIDT.

Associate Professors: HERBERT R. BARGHUSEN, KAREL F. LIEM, HARRY MONSEN, W. ANN REYNOLDS, PIERSON J. VAN ALTEN.

Assistant Professors: JOHN BOLT, MARTEN KERNIS.

Affiliated staff from other departments and institutions who participate in graduate teaching of M.S. or Ph.D. candidates in Anatomy are:

Professors: E. LLOYD DU BRUL, LUIS DE LA TORRE, MILTON B. ENGEL, ROY GILLETTE, ROBERT INGER, HERMAN MEDAK, ROBERT D. RAY, JOHN P. WATERHOUSE, RALPH M. WYNN, RAINER ZANGERL.

Associate Professors: NAOMI LEMKEY-JOHNSTON, ROBERT SCAPINO.

Lecturer: ARTHUR A. HIRATA.

COURSES FOR GRADUATES

301. **Gross Human Anatomy.** Gross morphology and function of the human body. F. W. 5 quarter hours. Staff.
302. **Cell Structure and Human Histology.** Structure and function of cells, fundamental tissues, and organs. F. W. 5 quarter hours. Staff.
303. **Human Neuroanatomy.** Morphological organization of the nervous system. Functional correlations of neural structures. Sp. 5 quarter hours. Staff.
350. **Advanced Anatomy.** F. W. Sp. 3 quarter hours. Staff.
410. **Concepts of Morphology.** Seminars on concepts of morphology are offered during different quarters by various faculty members. Each seminar relates to one of the following topics: human embryology, fetal anatomy (F.), principles of teratology (W. or Sp.), neuroendocrinology (Sp.), cytogenetics (W. or Sp.), and evolutionary morphology (W. or Sp.). 3 quarter hours each. Staff.
421. **Approaches and Methods in Anatomical Research.** Demonstrations and laboratories of technical procedures currently used in anatomical research. F. W. 2 quarter hours. Staff.
431. **Experimental Neurocytogenesis.** Factors underlying the inductance, differentiation, and subsequent maturation of the vertebrate neuron. The genesis of behavioral patterns, organelles, and certain enzyme systems in relation to neuronal development. Sp. (alternate years). 3 quarter hours. LaVelle.
433. **Experimental Morphogenesis.** Problems in the development and organization of animal eggs, with reference to polarity, symmetry, induction, and topogenesis. Special consideration of problems in fertilization, organization of the vertebrate body axis, fields and organogenesis, regulation, and regeneration. W. or Sp. (alternate years). 3 quarter hours. Schmidt.
434. **Developmental Immunobiology.** The relationship of immunology to problems of development in terms of the capacity of the embryo, fetus, or neonatal animal to respond immunologically to antigenic stimulation. Immunological methods as tools for the study of antigenic determinants in the developing embryo. W. (alternate years). 3 quarter hours. Van Alten.
435. **Morphologic and Physiologic Adaptations in Growth, Aging, and Injury.** Analysis of biological structure and physiology in vertebrate growth, aging, and injury. Sp. 3 quarter hours. Maibenco, Schmidt, Van Alten.
436. **Evolution of Functional Complexes in Vertebrates.** Adaptive modifications in functional complexes as observed in comparative studies of living vertebrates and the phylogenetic studies of fossil lineages. Methods of describing and interpreting morphological modification with emphasis on the biomechanics of the skeletal system. Sp. 4 quarter hours. Barghusen, Bolt, Liem.
437. **Cell Biology of Vertebrate Repair and Regeneration.** Analysis of the cytoarchitecture and molecular ecology of amphibian appendage regeneration,

correlated with specific tissue responses to trauma and repair in all vertebrates. W. or Sp. (alternate years). 4 quarter hours. Schmidt.

- 441. Nucleo-Cytoplasmic Interaction.** Structure of the nucleus, its role in transmission of genetic information, and its interaction with cytoplasmic factors. W. or Sp. (alternate years). 3 quarter hours. MacRae.
- 442. Fine Structure of Cells and Tissues.** Analysis of electron micrographs of cell membranes and organelles, as related to specific functions of cells and tissues. W. or Sp. (alternate years). 3 quarter hours. MacRae.
- 443. Morphogenetics.** Analysis of genetic, epigenetic, and environmental factors underlying the determination and variability of anatomical structure and function. W. or Sp. 4 quarter hours. de la Torre.
- 491. Seminar and Journal Club.** Presentation of research by invited lecturers. Presentation of current literature and research by students. F. W. Sp. 0 to 2 quarter hours.
- 493. Research in Anatomy.** F. W. Sp. 1 to 16 quarter hours. Staff.

Biological Chemistry

The department provides an active graduate training program with excellent facilities for graduate students pursuing work toward the Master of Science and Doctor of Philosophy degrees.

The objective in graduate training is to provide optimal opportunities for modern biochemical research. Although the orientation is not particularly clinical, the location in a large and active Medical Center adjacent to the University provides an ideal environment for fundamental biochemical studies at all biological and medical levels.

In general, the admission requirements are those which apply to all applicants for graduate work at the Medical Center. Since the approach to biological chemistry may be primarily chemical or biological, the requirements for graduate work in the department are flexible enough to permit admission of individuals of quite different backgrounds. Undergraduate training should include 16 semester hours of chemistry, including organic, quantitative analysis, and physical chemistry; eight semester hours of physics, including laboratory work in electricity, heat, mechanics, and sound; at least one thorough course in biology; and at least six semester hours of a modern language. If an applicant's undergraduate preparation is deficient, certain of these courses may be pursued without graduate credit after admission to the department. Students having a bachelor's degree, qualified medical and dental graduates, or students pursuing these professional degrees, are encouraged to undertake graduate work in biochemistry.

Candidates for the Master of Science degree in biological chemistry are required to complete 48 quarter hours of work. As part of these 48 quarter

hours, candidates are required to take the following courses: Biological Chemistry 301, 302, 410-A and 410-B, 411 or 412, 391 (four quarter hours), 491 (four quarter hours), and 493, and Chemistry 335, 336 and 347. Elective courses may be taken from courses offered by the Department of Biological Chemistry or by other departments (Anatomy, Chemistry, Microbiology, Pathology, Pharmacology, or Physiology).

Candidates for training beyond the degree of Master of Science must have earned this degree or met the requirements for the degree in the Graduate College or have completed equivalent work elsewhere. Students in good standing are encouraged to proceed directly to the Ph.D. degree without obtaining a M.S. degree. To do this, a student is required to have completed 48 quarter hours of graduate work, have passed the reading examination for one language, or had the equivalent training previously, and passed oral and written qualifying examinations given by the department. For non-professional students preference is given to those who seek the Ph.D. degree.

The requirements for the degree of Doctor of Philosophy include Biological Chemistry 301, 302, 410-A and 410-B, 411, 412, 391, 491, 493 (48 quarter hours); five quarter hours of another basic medical science course in the 400 series; Chemistry 301, 335, 336, 347, and a 400 series course. Additional elective courses may be taken as desired from offerings in Biochemistry or other departments to complete the requirements of 144 quarter hours or 96 quarter hours beyond the master's degree.

A minor in Biological Chemistry should include Biological Chemistry 301, 302, 491 (three quarter hours) and at least five quarter hours of formal 400 level course work in the department.

The thesis must conform to the general requirements of the Graduate College and must be of sufficient merit to warrant publication in full or in part in a recognized scientific journal. Either completion of six semester hours in formal course work at the college level in French, German, Russian, or Spanish or passing the reading examination satisfies the departmental language requirements.

GRADUATE TEACHING FACULTY

Professors: STEPHEN B. BINKLEY, JAMES A. HAYASHI, HENRY JEFFAY, CLARENCE A. JOHNSON (*Emeritus*), HERMAN MATTENHEIMER, TERRELL C. MYERS, ALFRED NISONOFF, M. E. RAFELSON, JR., HOWARD SKY-PECK, BERNARD WEISSMANN.

Associate Professors: ANATOLY BEZKOROVAINY, SUE HANLON, WILLIAM HARRISON, RALPH KATHAN, NEWTON RESSLER, EDWARD B. TITCHENER.

Assistant Professors: C. ARSENIS, CLYDE DOUGHTY, THOMAS O. HENDERSON, KLAUS KUELLNER, JANOS MOLNAR, EUNICE SCHUYTEMA, GERALD SIMON, KENNETH SWIATEK, JAMES VARY.

COURSES FOR GRADUATES

- 301. Biological Chemistry.** Discussion of the chemistry of the constituents of tissues and body fluids, digestion, absorption, and intermediary metabolism of lipids, proteins, and carbohydrates in health and disease, and the role of hormones, vitamins, and enzymes in the regulation of these processes; the application of this knowledge to the problems of disease. Lectures and conferences. F. 4 quarter hours. Staff.
- 302. Biological Chemistry.** Continuation of Biological Chemistry 301. Lectures and conferences. W. 4 quarter hours. Staff.
- 303. Biological Chemistry Laboratory.** Diversified laboratory types depending on the competence and interest of students. Laboratories range from highly structured experiments to small group projects in limited areas of Biochemistry. Sp. 3 quarter hours. Staff.
- 304. Biochemistry of Disease.** An advanced course considering in detail the biochemical disorders that underlie or are associated with human disease. Lectures and seminars. Sp. 4 quarter hours. Rafelson and Staff.
- 305. Introduction to Genetics.** Introduction to genetics covering classic genetics, Mendel's genetics, biochemical genetics, chromosomal inheritance, immunogenetics, population genetics, and microbial genetics. Sp. 3 quarter hours. Schuytema and Staff.
- 391. Biochemical Literature Review.** Discussion of assigned articles from biochemical journals. The course is designed to acquaint the student with biochemical literature preparatory to beginning research. F. W. S. 1 quarter hour. Staff.
- 401. Immunochemistry.** Chemistry of antigens, antibodies, immunoglobulins, and complement. Qualitative and quantitative immunochemical analysis. Antigen-antibody reactions. Crossreactions and inhibition reactions. Three lectures and one two-hour tutorial session per week. F. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352 or 353; Biological Chemistry 301, 302, 303; or consent of instructor. Nisonoff and Staff.
- 410-A and 410-B. Biological Research Techniques.** Discussion and laboratory work surveying and illustrating the practical aspects of biochemical methodology; techniques for the isolation, analysis, and characterization of biologically important substances; radioisotope techniques, enzyme assay. Lecture and laboratory. F. W. 4 quarter hours each. Prerequisite: Biological Chemistry 301. Staff.
- 411. Advanced Biochemistry, I.** An advanced lecture course considering enzymology, cell physiology, and the chemistry of the important classes of biological substances, including carbohydrates, lipids, amino acids, proteins, and nucleic acid. Sp. 5 quarter hours. Bezkorovainy and Myers.
- 412. Advanced Biochemistry, II.** An advanced lecture course considering biological oxidations, the pathways of metabolism, the control and regulation of metabolism, nutrition, etc. F. 5 quarter hours. Titchener.
- 413. Physical Biochemistry.** The course presents the nature of physical biochemical

problems and then considers the techniques employed in solving these problems. W. 5 quarter hours. Prerequisite: Biological Chemistry 301, 302, Physical Chemistry 335 and 336 or equivalent. Hanlon.

415. **Neurochemistry.** Biochemistry of nervous tissue, chemical models of memory, chemical basis of psychotic behavior. F. 3 quarter hours. Prerequisite: 301 and 302. Simon.
431. **Bacterial Genetics.** A lecture and tutorial course on understanding the genetics of bacteria and bacteriophage. Subjects include: structure and function of bacterial nucleus, chromosome, genes, gene replication, variation, mutation, transformation, transduction, conjugation, bacteriophage-host relationships, lysogeny, transfer of episomes and plasmids, analysis of recombinants, and chromosome mapping. Course includes critical evaluation of classical and current literature in tutorial sessions. Three lectures and one two-hour tutorial session per week. W. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, and 353; Biochemistry 301 and 302, or consent of instructor.
432. **Biochemical Genetics.** An advanced course designed to acquaint the student with the basic principles in biochemical genetics and to provide a critical evaluation of the current literature in the field. Three lectures and one discussion session per week. Sp. (alternate years). 4 quarter hours. Prerequisite: Biochemistry 301 and 302, or consent of instructor.
440. **Special Topics in Biochemistry.** An advanced course dealing with selected topics in biochemistry. The particular subjects vary from year to year. One to three topics are considered each time the course is given. Topics include: biochemistry of the hormones, chemistry and function of steroids, biochemical genetics, chemistry of enzymes, phytochemistry, etc. Lectures. F. W. Sp. 3 quarter hours. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Staff.
464. **Recent Trends in Clinical Chemistry.** Studies based upon fundamental biochemistry and current theories in the literature: the nature and variations, in health and disease, of serum proteins and serum enzymes; electrophoresis; use of enzymes as diagnostic reagents; the role of computers in clinical chemistry; and reading assignments presented and discussed. One lecture-discussion each week. W. or Sp. 1 quarter hour. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Ressler.
491. **Seminar and Journal Club.** Student and faculty presentation of assigned subjects of current importance in biological chemistry and related fields. Assigned reading. F. W. Sp. 1 quarter hour. Staff.
493. **Research in Biological Chemistry.** Research on problems of biological importance with members of the graduate staff. F. W. Sp. S. 1 to 16 quarter hours each quarter.

Chemistry (Pharmaceutical)

The graduate program in pharmaceutical and medicinal chemistry em-

braces the recognized areas of pure chemistry and supports research projects of biological significance. Current research involves studies of reactions and reaction mechanism of biological importance; the isolation, characterization, and structure elucidation of compounds from natural sources; and the synthesis of potential medicinal agents. Studies designed to identify the structural prerequisites for pharmacological activity and to aid in the elucidation of the mechanisms of drug action at a molecular level are an important part of the program. In order to carry out these investigations the departmental laboratories are equipped with chromatographic equipment, infrared, ultraviolet, nuclear magnetic, and mass spectrometers, and equipment required for radio-tracer methodology. The department operates a biological screening program which furnishes biological data for students studying Medicinal Chemistry.

Admission to graduate study is subject to the general regulations and requirements of the Graduate College. The applicant's undergraduate education should include: (1) 36 semester hours of chemistry, including at least ten hours of general chemistry, four semester hours of analytical chemistry, eight semester hours of organic chemistry, and three semester hours of physical chemistry; (2) eight semester hours of physics; (3) six semester hours of mathematics; and (4) at least one course in biology.

Students possessing only the minimum credit in mathematics will be required to elect courses in analytical geometry and calculus. Highly qualified students lacking a certain entrance requirement may be admitted but will be required to remedy their deficiencies during the first calendar year.

Programs of study for new graduate students are individually developed and are based upon research interests, academic backgrounds, and the results of placement examinations. All students must, however, satisfy all requirements of the Graduate College and must complete a satisfactory dissertation reporting independent research. Students who plan to become candidates for the degree of Doctor of Philosophy must:

1. Pass a series of cumulative examinations in their major area of chemistry and demonstrate satisfactory knowledge through course work and/or examination in the other areas of chemistry.
2. Demonstrate a reading knowledge of one foreign language by submitting credit for the equivalent of two years of college level courses or by satisfactorily completing a "reading" examination of a language.

During their first quarter, students will be expected to select their research adviser and research project.

The Department of Chemistry annually awards a number of teaching and research assistantships. Students may also apply for fellowships to the Graduate College, the American Foundation for Pharmaceutical Education, the Public Health Service, and the National Science Foundation.

GRADUATE TEACHING FACULTY

Professors: MADELEINE F. BARNOTHY, LUDWIG BAUER, CHARLES L. BELL, DOMINICK A. COVIELLO, RALPH DANIELS, JAMES E. GEARIEN, E. R. KIRCH, ALFRED J. PERKINS.

Associate Professor: NORMAN R. JOSEPH.

Assistant Professors: ROSE ANN GRUNDMAN, ALFRED VON SMOLINSKI.

COURSES FOR GRADUATES

- 301. Qualitative Organic Analysis.** A study of the methods employed in the identification of organic compounds. Particular emphasis is placed upon the physical and chemical properties which lead to the elucidation of chemical structure. Instrumental and chemical methods for the identification of functional groups are discussed. Two class discussions and a minimum of ten hours laboratory work each week. S. 5 quarter hours. Prerequisite: One year of organic chemistry. Gearien.
- 315. Modern Physics.** Basic tenets of relativity and quantum theories are presented. Topics to be discussed include elementary particles, as well as atomic and nuclear structure. The biological and chemical implications of physics are stressed. Three lectures each week. Usually offered in alternate years with Chemistry 325. W. (alternate years). 3 quarter hours. Prerequisite: One year of general physics and Mathematics 111. Barnothy.
- 325. Radioactive Isotopes.** The properties and methods of the detections of radiations are discussed. The use of tracers in radiobiology, medicine, and chemistry, including the applications of therapy and health physics, will be included. Two lectures and one four-hour laboratory period each week. Usually offered in alternate years with Chemistry 315. W. (alternate years). 3 quarter hours. Prerequisite: One year of general physics. Barnothy.
- 335. Physical Chemistry.** Atomic and molecular structure, chemical thermodynamics, phase equilibria, chemical equilibria, surface chemistry, electrochemistry, and chemical kinetics are discussed in this two-quarter sequence of courses. Four class meetings each week. W. 4 quarter hours. Prerequisite: One year of calculus. Perkins.
- 336. Physical Chemistry.** Continuation of Chemistry 335. Four class meetings and one four-hour laboratory period each week. Sp. 5 quarter hours. Perkins.
- 342. Medicinal Chemistry.** The study of modern synthetic drugs with regard to their nomenclature, methods of synthesis, and relationship to drugs having similar therapeutic properties. The chemical and physical properties of these drugs are related to their pharmacological activities. Four lectures each week. W. 4 quarter hours. Prerequisite: One year of organic chemistry. Kirch.
- 343. Chemical Toxicology.** A course concerned with the common sources, chemistry of the physiological action, methods of isolation, and identification of toxic agents commonly encountered as industrial hazards and as the cause of accidental or purposeful poisoning. Two lectures and two three-hour

laboratory periods each week. Sp. 4 quarter hours. Prerequisite: Organic chemistry. Kirch.

345. **Chemistry of Natural Products.** The occurrence, origin, biological significance, nomenclature, physical and chemical properties, methods of isolation, and pharmaceutical uses of important natural substances are studied. Particular attention is given to the sugars, sugar alcohols, polyhydroxyacids, gums, mucilages, pectins, glycosides, fats, waxes, sterols, hormones, vitamins, enzymes, and essential oils and resins. Four lectures. F. 4 quarter hours. Prerequisite: Chemistry 113 and 123. Kirch.
347. **Organic Chemistry.** A continuation of the study of organic chemistry with emphasis on the application of general and special reactions to organic synthesis. Three lectures each week. F. 3 quarter hours. Prerequisite: One year of organic chemistry. Coviello.
348. **Organic Chemistry Laboratory.** A continuation of the study of organic chemistry with emphasis on techniques used in the organic chemistry laboratory. Methods not usually encountered in the basic courses in organic chemistry are stressed. Eight hours of laboratory each week. F. 2 quarter hours. Prerequisite: One year of organic chemistry. Coviello.
349. **Pharmaceutical Assaying.** Conferences, library, and laboratory experimentation related to methods for the detection and determination of impurities as well as the major components of chemicals and medicinal products. Critical evaluations and examinations of general procedures are included. Topics include all forms of chromatography, electrophoresis, non-aqueous titrations, and E.D.T.A. titrations. F. 4 quarter hours. Prerequisite: Quantitative analysis. Kirch.
355. **Advanced Analytical Chemistry.** A mathematical treatment of analytical equilibria. Numerical and graphical methods of calculation of titration curves, titration errors, and related equilibria. Equilibria involving acid-base, precipitation, redox, and complexation interactions are discussed. Use of computers in iterative computations. Four lectures. 4 quarter hours. Prerequisite: Quantitative analysis, one year of physical chemistry, organic chemistry, physics. F. (alternate years). von Smolinski.
356. **Instrumental Analysis Laboratory.** The practical aspects of instrumental analysis are emphasized in this course. Experiments illustrating the basic techniques used in electroanalytical and spectroanalytical chemistry are designed to enable the student to attain some familiarity with instrumental methods. Analytical determinations using potentiometry, polarography, amperometry, coulometry, and other electrometric methods as well as analytical applications of electronic and vibrational absorption spectrometry, flame photometry, NMR spectrometry, gas chromatography, etc., will be included in the laboratory curriculum. Flexibility in the selection of experiments will be allowed so that the student may gain information suitable to his background, experience and research interest. One one-hour lecture and seven hours of laboratory work each week. F. 4 quarter hours. Pre-

requisite: Mathematics 111, Chemistry 122, Chemistry 121, and Physics 113. von Smolinski.

- 401. Advanced Organic Chemistry.** A systematic study of organic reactions according to their reaction types is presented. An evaluation of the use of these reactions in the synthesis of polyfunctional compounds is discussed. Four lectures each week. Sp. 4 quarter hours. Prerequisite: One year of organic chemistry. Bauer.
- 402. Advanced Organic Chemistry–Theory.** A study of the theories of chemical bonding and reaction mechanism of organic molecules. Four lectures each week. W. 4 quarter hours. Prerequisite: One year of organic chemistry. Daniels.
- 403. The Chemistry of Heterocyclic Compounds.** The structure, physical properties, reactions, and synthesis of the five- and six-membered heteroaromatic systems are discussed. Three lectures each week. F. (alternate years with Chemistry 408). 3 quarter hours. Prerequisite: One year of organic chemistry. Bauer.
- 404. Advanced Inorganic Chemistry.** A systematic study of the elements based upon the periodic table and of current thought on the nature of the chemical bond. Sp. (even-numbered years). 5 quarter hours. Perkins.
- 405. Introduction to Chemical Thermodynamics.** An introduction to the fundamental theory of thermodynamics with emphasis on its application to chemical problems. Three lectures each week. W. (alternate years with Chemistry 411). 3 quarter hours. Prerequisite: One year of physical chemistry and calculus. Joseph.
- 408. Principles and Application of Stereochemistry.** A study of the theoretical aspects of optical isomerism, geometrical isomerism, and conformational analysis and their practical applications to stereoselective reactions. Three lectures each week. F. (alternates years with Chemistry 403). 3 quarter hours. Prerequisite: One year of organic chemistry. Daniels.
- 409. Special Topics in Analytical Chemistry.** Discussions and laboratory exercises designed to include newer methods of analytical chemistry. They will include microbiological methods, electrochemical methods, and chromatographic procedures. Three class meetings and ten to twelve hours of laboratory work each week. 5 quarter hours. Staff.
- 410. Molecular Spectroscopy.** An introduction to spectroscopic techniques used in determining molecular structure. The course includes an introduction to wave mechanics and concerns both the theory and application of vibrational, rotational, electronic, and nuclear magnetic resonance spectroscopy. Four lectures each week. Sp. 4 quarter hours. Prerequisite: One-year course in physical chemistry. Bell, Perkins.
- 411. Reaction Rates and Mechanisms.** This course will include discussions of reaction velocities in homogeneous and heterogeneous systems. Three class meetings each week. F. (alternate years with Chemistry 405). 3 quarter hours. Prerequisite: One year of physical chemistry. Joseph.

- 412. Atomic Structure and the Chemical Bond.** A discussion of the electronic structure of matter leading to the modern concept of valence and the chemical bond will be presented. The properties of molecules will be related to their structure. Three lectures each week. F. (alternate years). 3 quarter hours. Prerequisite: One year course in physical chemistry. Bell.
- 413. Naturally Occurring Bases of Medicinal Value.** The structures of natural products as determined by degradation and synthesis are discussed as well as the biogenetic pathways by which they are formed *in vivo*. Particular attention is directed to compounds of medicinal interest such as alkaloids and selected antibiotics. Three lectures each week. 3 quarter hours. Prerequisite: Chemistry 401 and 402. Coviello.
- 415. Theoretical Principles of Instrumental Analysis.** The theoretical principles underlying the methods of instrumental analysis are discussed with the aim of providing the future user of analytical instrumentation sufficient understanding of the essential theories and basic techniques involved. A concise presentation is made of the rationale and methodology concerning electroanalytical and spectroanalytical chemistry. Typical applications are discussed in some detail. A brief survey of modern trends and new developments is also included. Three lectures each week. W. 3 quarter hours. Prerequisite: Chemistry 335 and 336. von Smolinski.
- 491. Seminar in Pharmaceutical Chemistry.** Reviews of topics of current interest in chemistry presented by students, faculty, and guest scientists. F. W. Sp. 1 quarter hour.
- 493. Research in Pharmaceutical Chemistry.** Individual research under the direction of a member of the staff. F. W. Sp. 1 to 16 quarter hours.
- 494. Advanced Radioactive Isotope Methodology.** The course will include a discussion of and practice in the methods of preparing and analyzing pharmaceutical, chemical, biological, and other samples containing radioactive isotopes. Special emphasis will be placed on research uses. One-hour discussion and one four-hour laboratory period each week. Sp. 2 quarter hours. Prerequisite: Physics 325. Barnothy.

Histology (Dental)

Graduate study in histology in the College of Dentistry leads toward the degree of Master of Science. The program is devised to provide training for teachers and investigators in the field of histology as it applies more specifically to the basic sciences related to dentistry. A student, however, is required to have a knowledge of the entire field of histology as it applies to the human body.

Course requirements include a total of 16 quarter hours of formal courses of which five quarter hours are of 400 series courses within the department, and at least 16 quarter hours of Histology 493. Attendance at the Oral Research Seminar and the Seminar in Electron Microscopy is recommended. All gradu-

ate students include in their graduate program some time for participation in teaching.

A thesis on an original investigative problem is required.

Students completing the requirements for a master's degree in histology may apply for admission for work toward the Doctor of Philosophy degree in anatomy and must comply with requirements of that discipline for the doctorate.

GRADUATE TEACHING FACULTY

Professors: MILTON B. ENGEL, ROY GILLETTE, NICHOLAS G. GRAND, ARTHUR F. GRIMM, MAURY MASSLER, JULIA MEYER, JOHN P. WATERHOUSE.

Associate Professors: TAWFIK Y. SABET, CHRISTOPHER A. SQUIER.

Assistant Professors: DALE R. EISENMANN, A. E. ZAKI.

COURSES FOR GRADUATES

401. **Advanced Oral Histology.** Lectures and discussions pertaining to special subjects and problems in oral histology. F. 3 quarter hours. Prerequisite: General Histology. Eisenmann, Meyer, Sabet, Squier, Waterhouse, Zaki.
402. **Advanced Oral Histology.** Mechanisms of development of tissues; lectures and discussions. W. 3 quarter hours. Prerequisite: General Histology. Gillette.
403. **Biology of Mineralized Tissues.** Lectures and discussions concerning the formation, structure, and functions of bone, dentin, and enamel, with emphasis on mechanisms of mineralization. Sp. 3 quarter hours. Prerequisite: General Histology. Eisenmann, Sabet, Zaki.
493. **Research in Histology.** F. W. Sp. S. 1 to 16 quarter hours.

Medical Psychology

Graduate study in medical psychology leads to the degree of Master of Science. The purpose of this program is to acquaint the student with some of the basic theoretical concepts and empirical procedures currently employed within the areas of clinical and experimental psychology. Emphasis is placed on methodological problems and solutions typically encountered in the conduct of psychological research.

This course of study is a three-quarter sequence and is designed for individuals with a previous background in medical science. At present, enrollment is open to junior and senior year medical students pursuing a medical curriculum in which the vacation and two alternate quarters occur consecutively.

A total of 48 quarter hours is required to complete the M.S. degree in medical psychology. Of this total, 22 hours are taken in four core courses which are required of all students; viz. Medical Psychology 380, 400, 401 and 420. The remaining 26 quarter hours are taken in elective courses empha-

sizing physiological, social, or developmental approaches to the study of behavior and in thesis research (Medical Psychology 493).

All students are required to submit an approved research thesis during their last quarter of residence. A foreign language examination is not required.

GRADUATE TEACHING FACULTY

Assistant Professors: MICHAEL S. BLACK, HERMAN I. DIESENHAUS, ROBERT A. JENKINS, HERBERT M. KOHN, PAUL R. SINGER, THOMAS J. TUCKER.

COURSES FOR GRADUATES

- 380. Psychological Processes.** The basic psychological processes of sensation, perception, learning, emotion, and motivation will be covered including theories, methods of investigation, and their psychophysiology. This course is a prerequisite for all later work in the master's sequence. F. W. 6 quarter hours. Kohn, Tucker.
- 400. Statistics and Psychometrics.** The logical foundations of data analysis and evaluation covering central tendency, correlation, factor analysis, small sample statistics, and nonparametric methods. F. 5 quarter hours. Jenkins.
- 401. Measurement and Experimental Design.** Research methods in psychology. The logical and empirical foundations of data production. W. 5 quarter hours. Prerequisite: Psychology 400. Psychology 400 and 401 are prerequisites for all later work in the master's sequence. Black.
- 420. Models of Behavior Disorder.** A variety of models of behavior disorder will be outlined from the most molecular approach, the genetic-biochemical, to the largest in terms of units, the epidemiological. This course is a prerequisite for all later work in the master's sequence. F. W. 6 quarter hours. Diesenhause, Singer.
- 493. Research in Medical Psychology.** Research investigations of problems in medical psychology. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Microbiology

The graduate program in microbiology is designed to give the students a solid foundation in general biochemistry and microbiology and, more specifically, in molecular and cellular biology involving immunology, bacteriology, and virology. A major feature of the upper level graduate courses in microbiology is the tutorial method of teaching. In addition to the reading, which is ancillary to the didactic portion of the course, each student is provided with 40 to 50 reprints on classical or current work. Then in a tutorial session with three or more staff members present, the students critically appraise the work. In this way, students develop a deeper insight into the validity of published work and enhance their ability to think and write in the field. Usually a single session will cover four or five reprints on related

subjects often with conflicting results. The students try among themselves the different concepts that each may have obtained from reading these papers. The staff provides general guidance in these discussions. With this background, a student can proceed to specialize in the area of his interest under the supervision of a departmental faculty member. Active research programs currently under investigation include: molecular and cellular immunology, molecular and cellular virology, microbial genetics, biochemical genetics, and pathogenic bacteriology and mycology. The program is designed to train individuals for careers in teaching and research positions in academic institutions, as well as for careers in research for government or industry.

Applicants with a bachelor's degree from an accredited liberal arts institution with majors in biology and chemistry are eligible. Students with the best academic backgrounds, as judged by a departmental graduate admissions committee, are selected for admission.

For the Master of Science degree, candidates are required to take the following courses: Microbiology 351, 352, and 353 and at least two formal microbiology courses in the 400 series (one of which must be either bacterial or biochemical genetics); Biological Chemistry 301, 302 and 410. In addition, 15 quarter hours must be earned in Microbiology 493; six quarter hours in Microbiology 491. A master's thesis should be completed by the end of the second year of a student's residence.

The requirements for the degree of Doctor of Philosophy include courses already completed for the master's degree plus a minimum of 15 quarter hours of elective didactic courses in the Microbiology 400 series; 10 quarter hours of didactic course work at the 400 level in biological chemistry; 30 quarter hours of Microbiology 493 and six quarter hours in Microbiology 491. Two years of one foreign language (college level) or one year each of two foreign languages is required; alternatively, a student may satisfy this requirement by passing examinations of the Educational Testing Service.

All Ph.D. candidates are expected to satisfactorily complete written and oral preliminary examinations shortly after they receive the Master of Science degree. Normally, students are able to write a doctoral thesis and complete the requirements for the Ph.D. degree by the end of the fourth year. All graduate students have the opportunity for a variety of teaching experience and are also expected to actively participate in the various departmental seminars.

GRADUATE TEACHING FACULTY

Professors: FREIDRICH W. DEINHARDT, SHELDON DRAY, JOHN E. KEMPF, ABRAHAM MARKOWITZ, ALFRED NISONOFF, EDWARD E. VICHER.

Associate Professors: TRUMAN O. ANDERSON, PETER BARAM, SAMUEL P. GOTOFF, CAROLYN W. HAMMOND, RIAZ-UL HAQUE, NEWTON KHOUBYARIAN, ARTHUR V.

KROEGER, LEON J. LEBEAU, ROBERT L. NORTHROP, ROBERT W. PUMPER, ABE WIDRA.

Assistant Professors: HERMAN AINIS, KATHERINE L. KNIGHT.

Staff of other departments participating in graduate teaching of M.S. and Ph.D. candidates in Microbiology are:

NICOLAS COSTEA, M.D., Associate Professor, Department of Medicine;
HELENE GUTTMAN, Ph.D., Professor, Department of Biologicigal Sciences, Circle Campus;
PAUL HELLER, M.D., Professor, Department of Medicine;
GEORGE GEE JACKSON, M.D., Professor, Department of Medicine;
OLGA M. JONASSON, M.D., Assistant Professor, Department of Surgery;
EDWARD A. LICHTER, M.D., Professor and Head, Department of Preventive Medicine;
MAURICE A. MUFSON, M.D., Associate Professor, Department of Medicine;
TAWFIK SABET, Ph.D., Associate Professor, Department of Histology;
PIERSON J. VAN ALTEN, Ph.D., Associate Professor, Department of Anatomy.

COURSES FOR GRADUATES

- 351. General Immunology.** Basic concepts and laboratory techniques in Immunology. Lectures: chemistry of antigens, antibodies and antigen-antibody reactions; antibody formation, hypersensitivity, immunogenetics, autoimmunity, Immunology of transplantation, immunity, immunological mechanisms of disease. Laboratory: immunization, qualitative and quantitative analysis of antigens and antibodies, isolation of immunoglobulins, preparation of pure antibodies, cellular synthesis of antibodies, *in vivo* and *in vitro* hypersensitivity reactions. Three lectures and six laboratory hours each week. F. 5 quarter hours. Dray, Knight, and Staff.
- 352. General Bacteriology.** Basic concepts and laboratory techniques in bacteriology, mycology, and protozoology. Lectures: cytology, nutrition, metabolism, classification growth, death and genetics of bacteria, systematic study of selected groups of organisms and their role in disease. Laboratory: light, dark field, phase, and fluorescence microscopy, methods of isolation, cultivation, identification and classification of bacteria and fungi, quantitation and control of bacterial populations. Three lectures and six laboratory hours each week. W. 5 quarter hours. Haque and Staff.
- 353. General Virology.** Basic concepts and laboratory techniques in virology. Lectures: the nature of animal, plant, and bacterial viruses, their structure and *in vivo* and *in vitro* host cell-virus interactions. Laboratory: modern methods of cultivation and isolation of cells and viruses and their application to the isolation, identification, purification and characterization of animal viruses. Three lectures and six laboratory hours each week. Sp. 5 quarter hours. Khoobyarian, Pumper, and Staff.
- 401. Immunochemistry.** Chemistry of antigens, antibodies, immunoglobulins, and complement. Qualitative and quantative immunochemical analysis.

Antigen-antibody reaction. Cross-reaction and inhibition reactions. Three lectures and one two-hour tutorial session per week. F. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, or 353; Biological Chemistry 301, 302, 303, or consent of instructor. Nisonoff and Staff.

402. **Immunobiology.** Biology of immunocompetent cells, antibody formation, immunity, hypersensitivity, autoimmunity, tumor immunology, and transplantation immunity. Three lectures and one two-hour tutorial session per week. F. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, 353 or consent of instructor. Dray, Markowitz, and Staff.
403. **Advanced Virology.** Biological and biochemical aspects of viruses; mechanisms of viral synthesis; pathogenesis at the cellular and host levels, interferon and interference; genetics of animal and bacterial viruses. Three hours lecture and two hours conference per week. W. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, 353 or consent of instructor. Kempf and Staff.
404. **Medical Mycology.** Lectures, conferences, and laboratory work covering general, opportunistic, and the pathogenic fungi which cause superficial and systemic infections in man. The immunology, pathology, laboratory diagnostic procedures, chemotherapy, morphology, and biochemical reactions of the medically important fungi will be considered in detail. Two lectures and four hours laboratory per week. S. (alternate years). 2 quarter hours. Prerequisite: Microbiology 325, 326 or 351, 352, 353. Widra.
407. **Oncogenic Viruses.** Oncogenic viruses, viruses producing leukemia, papillomata, and specific or generalized neoplastic diseases. Three hours lecture and two hours conference per week. Sp. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, 353 or consent of instructor. Deinhardt and Staff.
408. **Immunogenetics.** Genetic control of soluble and cellular antigens in microorganisms, drosophilae, and mammals. Immunogenetics in reproduction and differentiation, histocompatibility, transplantation, and tolerance. Three lectures and one two-hour tutorial session per week. W. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, 353 or consent of instructor. Dray, Knight, and Lichter.
430. **Diagnostic Medical Microbiology.** A lecture, seminar, and laboratory course in the principles, theory, and practice of diagnostic microbiology. Nutrition and inhibition as factors in design of isolation media; biochemical and genetic approach for characterization of bacteria; serological techniques in the specialization of bacteria; micro-techniques in diagnostic microbiology; validity and reliability levels in antibiotic sensitivity testing; quality control in diagnostic bacteriological work. S. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352 and 353. LeBeau, Vicher, and Staff.
431. **Bacterial Genetics.** A lecture and tutorial course on understanding the genetics of bacteria and bacteriophage. Structure and functions of bacterial nucleus, chromosome, genes, gene replication, variation, mutation, trans-

formation, transduction, conjugation, bacteriophage-host relationships, lysogeny, transfer of episomes and plasmids, analysis of recombinants, and chromosome mapping. Course includes critical evaluation of classical and current literature in tutorial sessions. Three lectures and one two-hour tutorial session per week. W. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352, and 353. Biochemistry 301 and 302, or consent of instructor. Staff.

432. Biochemical Genetics. An advanced course designed to acquaint the student with the basic principles in biochemical genetics and to provide a critical evaluation of the current literature in the field. Three lectures and one discussion session per week. Sp. (alternate years). 4 quarter hours. Prerequisite: Biochemistry 301 and 302, or consent of instructor. Staff.

433. Bacterial Physiology. A lecture and tutorial course on the physiology and metabolism of bacteria. Nutrition, mechanisms of permeability, enrichment cultures, energy metabolism, respiratory enzymes, aerobic and anaerobic respiration, phototrophic and chemotrophic bacteria, metabolism of carbon and nitrogen compounds, fixation of carbon dioxide, growth and synchronization of cell division, synthesis and release of virulence factors of bacteria, sporogenesis and germination. Course includes critical evaluation of classical and current literature in tutorial sessions. Three lectures and one two-hour tutorial session per week. F. (alternate years). 5 quarter hours. Prerequisite: Microbiology 351, 352 and 353, Biochemistry 301 and 302, or consent of instructor. Staff.

491. Seminar in Microbiology. Presentation of topics of current interest in microbiology by guest scientists, faculty, and students. F. W. Sp. 1 quarter hour. Dray and Staff.

493. Research in Microbiology. Individual research on problems in immunochemistry, immunobiology, immunogenetics, virology, bacteriology (genetics and metabolism), and mycology. F. W. Sp. S. 1 to 15 hours each quarter. Staff.

Oral Pathology

Graduate study in oral pathology leads toward the degree of Master of Science. The program is devised to provide training for teachers and investigators in the field of oral pathology and a knowledge of the entire field of pathology. A training in diagnostic pathology, including cytology, is provided.

In addition to the general requirements of the Graduate College, the applicant must have received his Doctor of Dental Surgery degree, or have earned a degree in basic science.

Courses required of all candidates for the Master of Science degree in oral pathology include at least 22 quarter hours of research in Oral Pathology 493, four quarter hours of Seminar in Oral Pathology 491 (W. Sp.) and 16 quarter hours or more of formal courses, including four quarter hours in Advanced

Oral Pathology 401 (F.) and 402 (W.) or their equivalent, and two quarter hours in Advanced Oral Histology 401 (F.) or 402 (W.).

Further formal courses will be determined by the major adviser. The following courses are recommended:

Concepts of Morphology (Anatomy 410, F. W. Sp. 8 quarter hours).

Microbiology and Immunology (Microbiology 351. F. 5 quarter hours).

Biological Chemistry (Biological Chemistry 301 and 302. F. W. 8 quarter hours).

Human Physiology (Physiology 301 and 302. F. W. 10 quarter hours).

General and Special Pathology including Clinical Pathology (Pathology 325, F. W. Sp. 24 quarter hours).

Graduate students for the M.S. degree in oral pathology include in their timetable some participation in teaching in the departmental programs in the College.

A thesis incorporating an original investigation is required.

Students completing the requirements for the Master of Science degree in oral pathology may apply for admission for work toward the Doctor of Philosophy degree in pathology. Some students by-pass the M.S. degree and proceed directly to the Ph.D. degree.

GRADUATE TEACHING FACULTY

Professors: NICHOLAS G. GRAND, DANIEL M. LASKIN, HERMAN MEDAK, JULIA MEYER, JOHN P. WATERHOUSE.

Associate Professors: STANLEY J. GERSON, SHU-YUNG WANG.

Assistant Professor: ERWIN P. BARRINGTON.

COURSES FOR GRADUATES

401. Advanced Oral Pathology. The course presents an analysis of the important pathologic processes as they manifest themselves in the oral cavity and adjacent regions. Lectures, demonstrations, and discussions. F. 2 quarter hours. Prerequisite: Physiology 301, Microbiology 351, Pathology 325, Oral Pathology 325, or consent of instructors. Barrington, Gerson, Medak, Waterhouse.

402. Advanced Oral Pathology. The course presents an analysis of the effects of the principal disease processes upon the tissues and organs of the oral cavity and adjacent regions. Lectures, demonstrations, and discussions. W. 2 quarter hours. Prerequisite: Physiology 301, Microbiology 351, Pathology 325, Oral Pathology 325, or consent of instructor. Grand.

491. Seminar in Oral Pathology. Weekly reviews, reports and discussion of topics drawn from the literature and the material of surgical oral pathology. F. W. Sp. 2 quarter hours each quarter. Grand.

493. Research in Oral Pathology. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Oral Surgery

A degree of Master of Science is offered in oral surgery. The program is designed to provide training in research and teaching as well as a comprehensive basic science background. Prerequisites for admission are a Doctor of Dental Surgery degree from an accredited institution, with a minimum combined grade-point average of 3.5 in both preprofessional and professional work.

At least 20 quarter hours of Oral Surgery 493 are required for the Master of Science degree. In addition, 16 quarter hours of formal courses including five quarter hours at the 400 level are determined by the major adviser and may include Pathology 325, Anatomy 301, Oral Pathology 491, Histology 401, Pharmacology 325, Physiology 301, and others suited to the individual needs of the student. A thesis on an original investigative problem is also required.

A minimum of two years is necessary for completion of the program. During this period the student is required to devote a portion of his time to teaching and assisting in the department. Students in the combined didactic and clinical training program are registered in the Graduate College on a part-time basis during the internship and residency periods. Graduate credit is not granted for clinical work.

GRADUATE TEACHING FACULTY

Professors: AXEL G. ANDERSON, DANIEL M. LASKIN.

Associate Professor: EUGENE C. LEKAN.

COURSE FOR GRADUATES

493. **Research in Oral and Maxillofacial Surgery.** F. W. Sp. S. 1 to 16 quarter hours each quarter.

Orthodontics

The degree of Master of Science is offered in orthodontics. The program is primarily one of training for research and teaching in the basic and applied sciences in orthodontics.

All applicants must have the degree of Doctor of Dental Surgery from an accredited dental college, must meet the 3.5 minimum combined grade-point requirement of the Graduate College for undergraduate preprofessional and professional college courses, and must be approved by the departmental staff.

A residence of 21 consecutive months or two and one-third academic years is required. Those showing scholarly proficiency and research ability become candidates for the Master of Science degree and increase their residence to 24 months or two and two-thirds academic years. They must present an acceptable thesis on an original investigation and defend it by an oral examination. Students not taking the degree program but who successfully complete 21 months work without a thesis receive a certificate of pro-

iciency in orthodontics awarded by the department, not by the Graduate College.

Required courses for the Master of Science degree include Orthodontics 401 and at least 20 quarter hours in Orthodontics 493. Sixteen quarter hours of formal courses exclusive of seminars are required, not more than five quarter hours of which may be absolved by Orthodontics 401. Other quarter hours toward this requirement may be met by taking graduate courses in Anatomy, Histology 401 and 402, or other courses in the basic sciences. Additional courses may be required by the major adviser. Students must register for a full program of 16 quarter hours each quarter or spend additional time to complete requirements.

A brochure and application form are available to all applicants in Orthodontics, Room 1360, 808 South Wood Street.

GRADUATE TEACHING FACULTY

Professors: MILTON B. ENGEL, RICHARD L. HOFFMAN, EARL W. RENFROE.

Associate Professors: HOWARD ADUSS, BERNARD J. SCHNEIDER.

COURSES FOR GRADUATES

401. Orthodontics. An intensive course covering four quarters and including the study of the phylogeny of teeth, jaws, and head, comparative anatomy and physiology of the dental apparatus, applied functional anatomy and physiology of the human masticatory mechanism, growth and development of the head skeleton and the human dentition, both normal and abnormal, and the etiology of malocclusion and research methods pertaining to the field. F. W. Sp. S. 5 quarter hours each quarter. Only five quarter hours may be applied to the formal course requirement. Hoffman, Schneider.

493. Research in Orthodontics. Special research in fields appropriate to the major subject. F. W. Sp. S. 1 to 16 quarter hours each quarter.

Orthopaedic Surgery

Graduate study in orthopaedics is offered by the department leading to the degree of Master of Science. A unique opportunity exists to provide a limited number of individuals who expect to make careers of teaching and research with sound backgrounds in the related basic sciences, in scientific investigation, and in teaching.

Prerequisites are the degree of Doctor of Medicine and at least one year of internship. A candidate must also meet the general requirements for admission to the Graduate College. Of a total of 48 quarter hours of graduate work required for the degree, a minimum of five quarter hours in a formal 400 level graduate course and attendance at one seminar per quarter for three quarters in one of the related basic science disciplines are required. Among the 400 series courses, the following are suggested: Anatomy 421, Histology

403, Microbiology 402, Pathology 402, Physiology 412, Biometrics and Statistics 401 and 403, Radiology 410. A thesis is required and must conform to the requirements of the Graduate College. Attendance at staff conferences and seminars in orthopaedics is also required.

Post-doctoral traineeships in orthopaedics, including tuition, dependency allowances, and travel to scientific meetings, are available for those who are qualified.

GRADUATE TEACHING FACULTY

Professors: CLAUDE N. LAMBERT, ROBERT D. RAY.

Assistant Professors: JORGE GALANTE, WILLIAM F. HEJNA, RICHARD L. JACOBS, WILLIAM MELTZER.

COURSES FOR GRADUATES

491. **Seminar in Orthopaedics.** Weekly reviews, reports, and discussions of topics related to the musculo-skeletal system. F. W. Sp. S. 2 quarter hours.
493. **Research in Orthopaedics.** Individual research under the direction of a member of the staff in the field of the biological, biochemical, physiological, physical, and pathological aspects of the musculo-skeletal system. F. W. Sp. S. 1 to 16 quarter hours.

Pathology

Graduate study in pathology leads to degrees of Master of Science and Doctor of Philosophy. Pathology occupies the peculiar and unique position of bridge between preclinical and clinical disciplines. It seeks to ascertain the etiology and pathogenesis of disease; to study the agents or conditions which cause disease and to trace step by step the transformation of a normal tissue or process into an abnormal one. It utilizes in part a unique methodology, in part the techniques of all other basic and clinical sciences.

For the student of medicine, pathology is approached didactically in the second year. A qualified medical student may work with the techniques of pathology concurrently with his medical course in general pathology when he is gaining a fundamental background in the structure and function of normal and abnormal tissues.

Medical graduates who seek to become competent for the practice of anatomic or clinical pathology, or both, generally plan to take postgraduate residency training. If a teaching career is also contemplated, there are great advantages in initiating at an early stage a sequence of studies leading to a graduate degree in the specialty of pathology.

Students with a bachelor's degree in medical technology and others not seeking the degrees of Doctor of Medicine or Doctor of Dental Surgery, but with a thorough grounding in biological sciences in undergraduate courses including physiology, histology, and anatomy, who desire to pursue a teaching

and research career in medical science, may be admitted. In the absence of preliminary course work which can be adequately evaluated, the department may require a written examination. These students must fulfill certain basic course requirements which should include: Anatomy 301, 302; Biological Chemistry 301, 302; Physiology 301, 302, 303 or courses selected which are relevant to their chosen program of study and have prior approval as equivalents by the major adviser. These students must take Pathology 325 in the fall quarter and five quarter hours of 400 level courses.

The Master of Science degree in pathology is regarded as an adequate and significant terminal degree for those whose ultimate objective is practice, teaching, and research in pathology. The Ph.D. degree will interest those looking to careers in research and teaching more specifically.

The formal requirements of 48 quarter hours for the M.S. and 144 quarter hours for the Ph.D. degree are set forth in the general instructions. Courses completed in the M.S. program count toward the Ph.D. degree.

Within this framework, the course requirements will be tailored individually for each candidate with the advice of the major adviser in order to provide a broad basis of knowledge in pathology and more specific training in the chosen area of research. Thus, highly recommended courses are: Microbiology 402, 403; Graduate College 401; Radiology 410; Chemistry 325; Anatomy 433; Biological Chemistry 410; and Physiology 401 and 486. Attendance is required at certain staff and pathology conferences and at seminars.

Theses for both M.S. and Ph.D. degrees are ordinarily based on the problem selected for investigation. Great latitude is allowed in this selection, and studies concerning any of the biological phenomena operating in health and disease are considered suitable provided the work is of adequate scope, dimension, and importance. The customary standards governing candidates for these degrees are required. Theses based on work other than experimental are not accepted.

GRADUATE TEACHING FACULTY

Professors: ORVILLE T. BAILEY, GRANVILLE A. BENNETT, GEORGE M. HASS, CECIL A. KRAKOWER, DANIEL M. LASKIN, ELIE P. LEROY, ELIZABETH A. MCGREW, SAMUEL NERENBERG, CONRAD L. PIRANI, MARTIN A. SWERDLOW, FRANK L. TROBAUGH, JOHN P. WATERHOUSE.

Research Professor: HUBERT R. CATCHPOLE.

Associate Professors: JULIA MEYER, NEWTON RESSLER, ROGER D. SMITH, FRANCIS J. TENCZAR, RUTH L. WONG.

Assistant Professor: MALCOLM VYE.

COURSES FOR GRADUATES

325. General and Special Pathology Including Clinical Pathology. The basic

principles of pathological processes, including tissue injury and repair, inflammation, circulatory disturbances, retrograde processes, and tissue responses to specific infectious agents and neoplasms, are considered in the first part of the course. In the latter part of the course, the disease processes affecting each organ and anatomic system are considered in greater detail. The laboratory exercises are designed to correlate and interpret the gross, microscopic, and functional changes occurring in diseased tissues. Lectures, demonstrations, sectional conferences, and laboratory. Thirteen hours each week. F. W. Sp. 24 quarter hours (8 quarter hours each quarter). Prerequisite: Anatomy, histology, biological chemistry; at least introductory work in microbiology and physiology. Staff.

- 401. Experimental Pathology.** Lecture, seminar, and laboratory course in the essentials of experimental pathology. Limited to eight qualified students. F. 5 quarter hours. Prerequisite: Undergraduate courses in pathology and anatomy, including histology. Catchpole.
- 402. Histochemistry.** Lecture and laboratory course in methods and results of investigation in histochemistry. Fields covered depend on interests of students and may include work with inorganic substances, carbohydrates, vitamins, hormones, nucleic acids, enzymes, and amino acids. Limited to eight students. Sp. 5 quarter hours. Prerequisite: Biological chemistry and histology. Catchpole.
- 403. Physiological Basis of Pathology.** Lecture, seminar, and laboratory in physiological mechanisms underlying abnormal structure and function. Limited to eight qualified students to be selected after an interview. W. 5 quarter hours. Prerequisite: General pathology, physiology, biological chemistry, and anatomy. Catchpole.
- 404. Ultrastructural Pathology.** Lecture and seminar in the ultrastructural pathology of kidney, gastrointestinal tract, liver, muscle, and bone. W. 5 quarter hours. Prerequisite: General Pathology. Smith, Vye, and Staff.
- 405. Experimental Oncology.** Lecture and laboratory course in problems of experimental carcinogenesis. Limited to six qualified students. S. 3 quarter hours. Smith and Staff.
- 464. Recent Trends in Clinical Chemistry.** Studies based upon fundamental biochemistry and current theories in the literature: the nature and variations, in health and disease, of serum proteins and serum enzymes; electrophoresis; use of enzymes as diagnostic reagents; and the role of computers in clinical chemistry; reading assignments presented and discussed. One lecture-discussion each week. W. or Sp. 1 quarter hour. Prerequisites: Biological Chemistry 301 and 302, or equivalent. Ressler.
- 491. Pathology Seminar.** Weekly seminar covering selected fields of interest and research in pathology. F. W. 2 quarter hours each quarter. Staff
- 493. Research in Pathology.** F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Pedodontics

The degree of Master of Science is offered to students in pedodontics who wish to prepare themselves for an academic career of teaching and research. Applicants must have the degree of Doctor of Dental Surgery or Doctor of Dental Medicine from an accredited dental college and must meet the 3.5 minimum grade-point requirement of the Graduate College, combining undergraduate preprofessional and professional college course work. Approval by the staff is required.

A minimum residence of 18 months, or two academic years, is required. The curriculum is varied and arranged to best suit the academic objectives of the candidate. The student pursues professional postgraduate clinical courses concurrently with his graduate studies without credit toward the graduate degree.

An acceptable thesis based on original research is required. The thesis may be conducted utilizing any basic science discipline, but must be oriented to problems related to pedodontics.

Required courses for the Master of Science degree include Pedodontics 310, 401, and at least 16 quarter hours in Pedodontics 493. Additional courses may be required by the major adviser to complete the basic quarter hour requirements of the Graduate College.

GRADUATE TEACHING FACULTY

Professor: MAURY MASSLER.

Associate Professor: DONALD E. ORE.

COURSES FOR GRADUATES

- 310. Principles and Methods in Dental Research.** Review and evaluation of research methods in cariology, periodontology, endodontics, malocclusion, and other oral diseases. Emphasis is given to experiment design and strategy of research during the winter quarter. F. W. Sp. 1 quarter hour each quarter. Massler.
- 401. Dental Pediatrics.** Physical, mental, and emotional growth and development are studied. Areas of special interest, such as pediatric problems in health and disease, the handicapped, metabolic disturbances, diet and nutrition, and preventive dentistry, are related to specialized dental treatment and research. F. W. Sp. 1 quarter hour each quarter. Ore.
- 493. Research in Pedodontics.** F. W. Sp. S. 1 to 16 quarter hours each quarter. Massler, Ore.

Pharmacognosy

Programs leading to the degrees of Master of Science and Doctor of Philosophy are offered in pharmacognosy.

Prerequisites for admission are the general requirements of the Graduate College.

Reading proficiency in a scientific language other than English is required. This requirement may be satisfied by either two years of college level work or by examination. The language requirement must be fulfilled no later than the first year of work on the Ph.D.

Assistantships in pharmacognosy are available to qualified students. Candidates for the Ph.D. degree are required to participate in undergraduate teaching.

A proficiency examination which covers the fundamental principles of biological sciences, contingent upon the nature of the research problem, will be given to all applicants to evaluate their respective needs.

The following courses are required of all students seeking advanced degrees in pharmacognosy: Pharmacognosy 301 and 302. Highly qualified students, lacking Pharmacognosy 231, 232, 233 or their equivalent, may be admitted but will be required to remedy their deficiencies during the first calendar year. Candidates for the degree of Master of Science must have completed not less than five quarter hours and candidates for the Doctor of Philosophy not less than ten quarter hours of 400 level formal courses in pharmacognosy.

Supporting programs including such courses or minors may be chosen from the following: Biological Chemistry 301, 302; Chemistry (Pharmaceutical) 345, 349, 409; Pharmacology 325, 326, 493.

GRADUATE TEACHING FACULTY

Professors: FRANK A. CRANE, NORMAN R. FARNSWORTH, EDWARD S. MIKA, RALPH W. MORRIS.

Associate Professor: CONRAD A. BLOMQUIST.

COURSES FOR GRADUATES

301. **Plant Anatomy.** A microscopic study of the structure of vascular plants, with particular attention to the development of the vascular systems in all parts of the plant. Two lectures and two three-hour laboratory periods each week. W. 5 quarter hours. Crane.
302. **Plant Physiology.** A study of life processes in plants, with particular attention to the cell as the fundamental functional unit. The basic principles of plant metabolism are emphasized in relation to essential elements, energy relationships, and other environmental factors. Three lectures and one three-hour laboratory period each week. S. 5 quarter hours. Mika.
303. **Chemotaxonomy.** A chemotaxonomic study of plants, with particular emphasis upon those of drug importance. Relationship of the principal orders and families, rules of nomenclature, systems of classification, and chemical composition are considered. Laboratory work includes identification of species, together with the collection, identification, and preservation of plant

specimens. Two lectures and three three-hour laboratory periods each week. Sp. 5 quarter hours. Staff.

304. **Genetics.** A consideration of the fundamental principles of biological inheritance, and the application of these in the study of the plant and animal life. Three lectures and two three-hour laboratory periods each week. W. 5 quarter hours. Staff.
306. **Allergens.** An atmospheric survey and study of the wind-borne pollen and fungi spores; the identification and distribution of hay fever plants and the practical application of these studies. Two lectures and one three-hour laboratory period each week. Sp. S. 3 quarter hours. Staff.
310. **Bioassay.** Official, industrial, and general bioassay procedures are studied, with emphasis on their applicability. Their reliability is considered on a statistical basis. Laboratory demonstration periods will emphasize the design, setting-up, and analysis of representative bioassay preparations. Two lectures and two three-hour laboratory demonstration periods each week. W. (alternate years). 4 quarter hours. Morris.
314. **Histological Techniques.** A theoretical and practical development of the knowledge and skills essential to the preparation of biological materials for microscopic study. One lecture and two three-hour laboratory periods each week. F. or W. 3 quarter hours. Blomquist and Staff.
316. **Economics of Pharmacognosy.** A study of the traffic in crude drugs and related products, with consideration of the basic principles governing the production, distribution, and consumption of these materials. Three lectures or conferences each week. F. 3 quarter hours. Staff.
401. **Drug Plant Cultivation.** A consideration of the principles involved in the propagation and care of drug plants, combined with practical applications at the Drug Plant Experiment Station. Attention is given to the principles and practice of harvesting, preparation, storage, and marketing. Two lectures and three three-hour laboratory periods each week. Sp. or S. 5 quarter hours. Prerequisite: Pharmacognosy 302. Staff.
405. **Quantitative Pharmacognosy.** The use of quantitative methods and a study of their application in the microscopic and macroscopic evaluation of drugs, including the development of new methods. One lecture and two three-hour laboratory periods each week. W. (alternate years). 3 quarter hours. Prerequisite: Pharmacognosy 301. Staff.
410. **Pharmacognosy Research Techniques.** A lecture and laboratory course in the analysis of organisms and their products important to pharmacognosy, including the biological and chemical nature of constituents. Qualitative and quantitative aspects of chromatographic, spectrophotometric, gravimetric, and volumetric determinations of the natural products will be presented. Sp. or S. 5 quarter hours. Prerequisite: Pharmacognosy 301, 302, Chemistry 345, Pharmacy 440-Chromatography. Staff.
491. **Seminar in Pharmacognosy.** F. W. Sp. 2 quarter hours.
493. **Research in Pharmacognosy.** F. W. Sp. S. 1 to 16 quarter hours per quarter.

Pharmacology

Pharmacology is one of the basic medical sciences in which graduate study is available only at the Medical Center. The program of graduate study takes cognizance of the fact that pharmacology is the most rapidly expanding interdisciplinary science. Pharmacology is the science which deals with the qualitative and quantitative aspects of the effects of chemical compounds upon the living organism. Specialization is offered at the molecular as well as at the clinical level, and includes studies of drug metabolism, effects of drugs on the peripheral nervous system, brain, behavior, cardiovascular system, intermediary metabolism, and enzyme systems of experimental animals and of man.

The study of pharmacology requires a thorough knowledge of chemistry, biochemistry, and physiology. Depending upon the area of research specialization, competency in microbiology, anatomy, biophysics, or pathology may be required. Accordingly, the programs in pharmacology leading to the degrees of Master of Science and Doctor of Philosophy require broad training in basic medical sciences as well as advanced courses in pharmacology.

The curriculum is designed to train candidates for teaching in medical schools and for research in universities, industry, and governmental laboratories. Preference is given applicants who have completed an undergraduate major in biological sciences or chemistry, and who are interested in a teaching and research career in the medical sciences.

Candidates for the degree of Master of Science are required to complete 48 quarter hours. These must include Pharmacology 325, 326, or their equivalent, at least 24 quarter hours in Pharmacology 493, and a total of 16 quarter hours in formal courses, including five quarter hours at the 400 level. Additionally, a research thesis must be completed to fulfill the requirements for the Master of Science degree.

Candidates for the degree of Doctor of Philosophy are required to complete Pharmacology 325, 326, or their equivalent, and to earn a minimum of 48 quarter hours in Pharmacology 493 and 16 quarter hours in formal courses in the 400 series. The selection of courses is made by a qualifying committee and the student's adviser. Proficiency in one foreign language is required for the Doctor of Philosophy degree. The thesis for the doctorate should be of such merit as to warrant publication in part or in full in a recognized scientific journal. Participation in teaching in laboratories, conferences, and seminars is part of the curriculum of all degree candidates.

Pre- and postdoctoral traineeships in pharmacology, including tuition, dependency allowances, and travel to scientific meetings, are available to qualified students. Equivalent financial support may be made available to highly qualified non-citizens.

GRADUATE TEACHING FACULTY

Professors: MAYNARD M. COHEN (Neurology), J. FRANCIS HARTMANN (Neurology), GEORGIANNA JAGIELLO (Pediatrics), J. W. MAAS (Psychiatry), EVERETT W. MAYNERT, MARTIN P. SCHULMAN, NEENA B. SCHWARTZ (Psychiatry), THEODORE R. SHERROD, KLAUS R. UNNA.

Associate Professors: EDMUND G. ANDERSON, HAROLD FEINBERG, GEORGE R. HONIG (Pediatrics), TADEUSZ MARCZYNSKI, BERNARD SALAFSKY, LESTER F. SOYKA.

Assistant Professors: RICHARD D. GREEN, LAWRENCE ISAAC.

Lecturers: R. BAKER, R. LLINAS.

COURSES FOR GRADUATES

- 325. Pharmacology.** Physiochemical basis of drug action; drugs affecting the peripheral, autonomic, and central nervous systems; drugs altering cardiovascular and renal systems; antispasmodics; autacoids. Lectures, correlation exercises, and laboratory, seven hours each week. W. 5 quarter hours. Staff.
- 326. Pharmacology, Toxicology, and Chemotherapy.** Chemotherapy of microbial and parasitic diseases; drugs altering neoplastic and viral diseases, toxicology of heavy metals, solvents, gases, insecticides; drugs affecting hematopoiesis; pharmacology of agents affecting endocrine system. Lectures, conferences, correlation exercises, demonstration, and laboratory, five hours each week. Sp. 4 quarter hours. Staff.
- 402. Biochemical Mechanisms of Drug Action.** Discussions of the kinetics of enzyme action and the role of drugs as inhibitors and activators of components of multi-enzyme systems as well as of specific enzymes. Advances in chemotherapy of neoplasia, antibiotics, and action of chemical mediators are in terms of analog inhibitors and enzyme-substrate interactions. Vitamins and hormones are discussed as cofactors for reactions and as control mechanisms for reaction sequences. Lectures. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326, or equivalent. Schulman.
- 405. Advanced Topics in Cardiovascular and Renal Pharmacology.** Drug action on the cardiovascular system and kidneys, with special emphasis on the failing heart, cardiac arrhythmias, electrolytes and the heart, and renal hemodynamics as influenced by drugs. Lectures. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326, or equivalent. Sherrod.
- 408. Metabolism of Drugs.** The metabolic fate of a variety of drugs will be presented in lectures, demonstrations, and laboratory exercises. The fate of drugs will be discussed in terms of general metabolic reactions including hydrolytic cleavage, oxidations, specific reductions, conjugations, and lethal syntheses. The special role of microsomes in drug metabolism will be emphasized. Lectures and demonstrations. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326 or equivalent. Schulman.

- 409. Chemical Structure and Biological Activity.** Analysis of action of drugs in relation to molecular structure and steric configuration; methods for defining and measuring drug action; nature of drug receptors; theoretical drug design. Structure-activity relationships will be exemplified by autonomic drugs, drugs acting on the neuromuscular synapses of the striated muscles, histamine and antihistamines, local anesthetics, synthetic analgesics, steroid hormones, vitamins and sulfonamides. Lectures and demonstrations. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326. Staff.
- 410. Molecular Basis of Cardiac Drug Action.** An advanced course correlating the action of drugs on conduction, electric potentials, and contraction with cellular metabolism and energy transfer in heart muscle. Lectures. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Physiology 301, 302, 303 and Biochemistry 301, 302. Feinberg.
- 411. Steroid Drugs and Their Antagonists.** Biological, chemical, and pharmacological considerations of the male and female sex hormones and of adrenal cortical hormones. Biosynthesis, metabolism, excretion, and chemical detection of these hormones and consideration of their specific antagonists as a basis of the rational use of the naturally occurring and of synthetic steroids. Lectures. Quarter to be announced (alternate years). 2 quarter hours. Staff.
- 420. Pharmacology of Receptors, Neurones, and Synapses.** Lectures and discussions of drug actions on receptors; alterations of ionic permeability of neurones and synapses. Topics will include transmitter synthesis, storage, release, actions, and the various ways drugs can block or augment synaptic transmission in autonomic ganglia and the neuromuscular junction. Neuroregulatory, regenerative, and degenerative aspects of neurons will also be covered. Lectures. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325, 326 or equivalent. Anderson, Green, Salafsky.
- 421. Pharmacology of Central Integrative Processes.** Lectures and discussions on how drugs influence specific neuronal systems within the central nervous system. These will include laboratory methodology, discussions on how cells integrate information, and how drugs selectively affect these processes. Emphasis will be placed on the neurophysiology and pharmacology of the brain stem and spinal cord. Lectures and demonstrations. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325, 326 or equivalent. Anderson and Staff.
- 423. Pharmacology of Behavior.** Lectures and discussions of drugs affecting sensory input, central integration, and behavioral output. Emphasis will be placed on EEG correlates of behavior and drug effects on sleep-wakefulness cycles, central regulation of thirst, hunger, and emotional behavior. Lectures and demonstrations. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326, or equivalent. Marczynski and Staff.

- 425. Pharmacology of Catecholamines.** The synthesis, degradation, storage, release, and reuptake of catecholamines will be discussed. The effects of these amines on metabolic as well as electrophysiological parameters will be examined. Lectures and demonstrations. Quarter to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326 or equivalent. Maynert and Staff.
- 426. Pharmacology of Putative Transmitters.** Discussions on the synthesis, storage, and anatomical distribution of possible transmitter substances in the central nervous system. Emphasis will be placed on drugs which interfere with the metabolism or actions of the putative transmitters. Acetylcholine, serotonin, histamine, and several amino acids will be examined in detail. Lectures. Quarters to be announced (alternate years). 2 quarter hours. Prerequisite: Pharmacology 325 and 326 or equivalent. Anderson and Staff.
- 491. Pharmacological Seminar.** Time to be arranged; 1 quarter hour each quarter. Staff.
- 493. Research in Pharmacology.** Supervised research in area of specialization. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Pharmacy

Graduate study in pharmacy leads to the degrees of Master of Science and Doctor of Philosophy. These programs are designed so that the candidate will receive an adequate background in the basic physical and biological sciences as well as the pharmaceutical sciences and the related health disciplines. Sufficient flexibility is permitted so that the candidate can develop himself in breadth and depth in selected areas of specialization. Graduate study in pharmacy prepares qualified individuals for teaching, industry, and research in the field of pharmacy.

Admission to graduate study in pharmacy is subject to the general regulations of the Graduate College. The applicant should have received a Bachelor of Science, Bachelor of Science in Pharmacy, or Bachelor of Pharmacy degree from a college of pharmacy. Applicants holding a Bachelor of Science or Bachelor of Arts degree from a college other than a college of pharmacy may be accepted if they are currently completing the requirements for a Bachelor of Science in the undergraduate curriculum in pharmacy. The undergraduate preparation should include, among others, the following: general and inorganic chemistry and qualitative analysis, eight semester hours; mathematics, including an introduction to the calculus, seven semester hours; organic chemistry, eight semester hours; physics, eight semester hours, biological chemistry, three semester hours; pharmacy, 20 semester hours; pharmacology, eight semester hours; quantitative analysis, including drug assaying, five semester hours. An elementary course in physical chemistry is advisable.

Students enrolled for their first year of graduate study may be examined

on their knowledge of the fundamental principles of the physical sciences and pharmaceutical technology and their ability to correlate these studies. The results of these examinations are the basis for recommendation to the final examination for the master's degree.

Of the minimum 48 quarter hours required for the Master of Science degree with a major in pharmacy, at least 16 quarter hours including five quarter hours at the 400 level must be completed in formal course work acceptable for graduate credit, and at least 20 quarter hours must be completed in Pharmacy 493 leading to the production of an acceptable thesis.

Students pursuing the degree of Doctor of Philosophy with a major in pharmacy are required to complete successfully the following sequence of courses in pharmacy and chemistry: Pharmacy 305, 410, 411, 440 (six quarter hours), and 310 or 402; and Chemistry (Pharmaceutical) 335, 336, and 356. These constitute the core or required courses, and total 30 quarter hours. All students are required to take Pharmacy 491, Seminar, for a total of six quarter hours. Attendance is required in Seminar each quarter whether or not it is taken for credit. Minor or elective courses, up to 25 quarter hours, may be selected from the graduate course offerings in Chemistry (Pharmaceutical), Biochemistry, Microbiology, Pharmacognosy, and Pharmacology.

A minimum of 75 quarter hours including those earned toward the Master of Science degree must be devoted to Pharmacy 493 and must culminate in the production of an acceptable dissertation. The research project must be an original investigation and should deal with some basic science aspect of general pharmacy, physical pharmacy, manufacturing pharmacy, or a closely related problem of pharmaceutical interest.

All graduate study programs in pharmacy are under the general supervision of the Head of the Department of Pharmacy. The candidate must select as his major adviser a member of the graduate faculty. This should ordinarily be done before the start of the second quarter in which the student is enrolled. The major adviser has immediate supervision of the candidate's program of study, subject to approval by the Head of the Department.

All doctoral candidates in the Department of Pharmacy must meet one of the following alternatives for the foreign language requirement: (a) pass a proficiency examination in German, French, or Russian, or another foreign language approved by the Departmental Graduate Committee, or (b) pass successfully (C or better) one academic year of college level work in one language, French, German, or Russian, or another foreign language approved by the Departmental Graduate Committee.

An examination, partly written and partly oral, is required of all doctoral candidates majoring in pharmacy. The examination is designed to demonstrate the student's knowledge of scientific principles and their application to pharmacy. On the basis of the results of this examination, the major adviser

may recommend the student for examination by the preliminary doctoral committee, or may recommend further preparatory study.

GRADUATE TEACHING FACULTY

Professors: MARTIN I. BLAKE, DWIGHT L. DEARDORFF, AUGUST LENBERGER.

Associate Professors: ANGEL S. ARAMBULO, HERBERT S. CARLIN, BERNARD ECANOW,
HAROLD J. RHODES, FREDERICK P. SIEGEL.

Assistant Professors: ROBERT G. MRTEK, DANIEL A. NONA.

COURSES FOR GRADUATES

- 301. Hospital Pharmacy Practice I.** This course provides principles, objectives, and methods of administration applied to management of a pharmacy service in a modern hospital. Three lecture or conference periods each week. F. 3 quarter hours. Prerequisite: Pharmacy 250. Carlin.
- 302. Hospital Pharmacy Practice II.** This course provides guided experience in planning, organizing, and managing the various administrative and professional areas of a hospital pharmacy service. Two lectures and four hours of practice each week. W. 3 quarter hours. Prerequisite: Pharmacy 301. Carlin.
- 305. Physical Pharmacy.** The problems encountered in the fabrication and preservation of dosage forms of medication are studied from the standpoint of the physico-chemical principles and laws which may lead to their solution. Chemical kinetics and catalysis are areas which are especially important. F. 3 quarter hours. Prerequisite: Pharmacy 123. Ecanow.
- 310. Pharmaceutical Manufacturing Unit Operations.** The study of the scientific principles in unit operations of pharmaceutical manufacturing. Two lectures and one four-hour laboratory per week. Sp. 3 quarter hours. Prerequisite: Pharmacy 305, or departmental permission. Ecanow.
- 402. Manufacturing Pharmacy.** Studies of the principles, processes, facilities, and systems used in the development, scheduling, preparation, control, and quality assurance of pharmaceutical products. Consideration of the physical, chemical, and biological interrelationships between ingredients, procedures, equipment, containers, and storage conditions. Lectures may be elected without laboratory work; they are prerequisite or co-requisite for laboratory work. F. W. Sp. S. 3 to 5 quarter hours each quarter for a total of not more than 15 hours. Prerequisite: Departmental permission. Deardorff.
- 405. Stability of Pharmaceutical Systems.** Theories used in the evaluation and prediction of the physical and chemical stability of drugs in pharmaceutical dosage forms are discussed. In addition, fundamental factors which affect drug degradation and procedures designed to enhance stability are examined. Experimental stability determinations of selected drugs are performed, and methods for improving shelf-life stability are explored. Two lectures and one three-hour laboratory session each week. Sp. (alternate years). 3 quarter hours. Prerequisite: Chemistry 336 or equivalent. Staff.

410. **Polyphasic and Disperse Systems, I.** A study of reversible and irreversible colloidal systems. Three lectures each week. Sp. 3 quarter hours. Prerequisite: One year of physical chemistry or the equivalent. Deardorff.
411. **Polyphasic and Disperse Systems, II.** Further study of colloidal electrolytes, and the liquid-gas, solid-gas, and liquid-liquid systems. Three lectures each week. S. 3 quarter hours. Prerequisite: One year of physical chemistry or the equivalent. Deardorff.
440. **Special Topics in Pharmacy.** A consideration of selected topics in pharmacy. Several specialized topics of pharmaceutical importance are presented. The specific topics may vary each time the course is offered. The topics to be considered include: rheology, micromeretics, physics of tablet compression, biopharmacy, adjusted solutions, drug extraction techniques, sustained release medication, aerosols, formulation, federal regulations concerning new drug testing, etc. F. W. Sp. S. 3 quarter hours each quarter. Staff.
491. **Seminar in Pharmacy.** Weekly reviews, reports, and discussions of topics drawn from the literature of pharmacy or from research. F. W. Sp. 3 quarter hours each quarter. Staff.
493. **Research in Pharmacy.** Individual research under the direction of a member of the staff. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Physiology

The graduate program of the Department of Physiology is designed to prepare students for careers in research and teaching. It accepts candidates for both Doctor of Philosophy and Master of Science degrees, and includes in its offerings a strong, interdisciplinary bioengineering program. A broad spectrum of formal, seminar, and technical courses provides students with solid grounding in fundamentals as well as unusual opportunities for specialization. Course programs developed jointly by the student and his adviser are chosen to meet best the individual requirements of students. Normally the candidate for the Ph.D. degree with only a bachelor's degree requires four years to complete his training. Doctoral candidates should be prepared with undergraduate course work in chemistry, through organic and preferably including physical chemistry; in mathematics, through calculus; and with at least one year of biology and physics. Normally, the Ph.D. candidate takes his comprehensive preliminary examination at the completion of his formal course work. The language requirement involves the successful completion of a one-year course (two semesters or three quarters) in one modern foreign language at the college level, or evidence acceptable to the department of fluency in such language; the requirement may also be satisfied by passing a reading course or the equivalent in a modern foreign language prior to taking the preliminary examination.

GRADUATE TEACHING FACULTY

Professors: ARNOLD V. WOLF (Head of the Department), RICHARD E. BEHRMAN,

PIETRO O. BRAMANTE, ARTHUR J. DERBYSHIRE, JAMES W. DOW, RUVEN GREENBERG, ARTHUR F. GRIMM, RAYMOND C. INGRAHAM, ERVIN KAPLAN, ARMAND LITTMAN, RUY V. LOURENCO, JOHN P. MARBARGER, SABATH F. MAROTTA, AKIRA OMACHI, NEENA B. SCHWARTZ, JOHN T. SHARP, NICHOLAS TOROK, GERALD A. WILLIAMS.

Associate Professors: GYAN C. AGARWAL, ROBERT C. ARZBAECHER, GLADYS A. COURTNEY, EARL E. GOSE, PHILIP L. HAWLEY, WILLIAM D. O'NEILL, THOMAS J. TUCKER, BERT L. ZUBER.

Assistant Professors: WILLIAM M. HAMBY, ROBERT F. LOIZZI, CHARLES H. RODGERS, THOMAS M. SABA, MILES L. STANDISH.

COURSES FOR GRADUATE STUDENTS

- 301. Human Physiology.** Comprehensive survey of mammalian physiology with special reference to man. Lectures, demonstrations, conference, and laboratory. F. 6 quarter hours. Staff.
- 302. Human Physiology.** Continuation of Physiology 301. Includes laboratory. W. 6 quarter hours. Staff.
- 303. Human Physiology.** Continuation of Physiology 302. No laboratory. Sp. 4 quarter hours. Staff.
- 304, 305, 306. Human Physiology.** Same as Physiology 301, 302, 303, except no laboratory. F. W. Sp. respectively. 4 quarter hours each quarter. Staff.
- 307. Applied Physiology.** Consideration in depth of a limited number of topics in physiology of primary importance to clinical personnel; cardiac failure, acid-base and electrolyte balance, edema, hormone interactions, metabolism, neurophysiology. W. 4 quarter hours. Prerequisite: Introduction to Human Physiology or equivalent. Hawley and Staff.
- 401. Physiology of the Endocrines.** Advanced study of the concepts of control of endocrine secretion; the mechanism of action of the hormones and other special problems in the field of endocrinology. Two two-hour lecture-conferences per week. W. (alternate years). 4 quarter hours. Prerequisite: Physiology 301, 302, 303 or equivalent. Schwartz.
- 405. Physiology of the Heart.** Advanced study of basic metabolic and functional determinants of cardiac activity. Discussion of modern views and newer clinical and experimental techniques in cardiology. One two-hour lecture-conference per week. Sp. (alternate years). 3 quarter hours. Prerequisite: Physiology 301, 302, and 303 or equivalent; Biochemistry 301 and 302. Staff.
- 413. Concepts in Biophysics.** A course to introduce the student to mathematical and physical concepts in biology. Four one-hour lectures per week. Sp. 4 quarter hours. Prerequisite: Physiology 301, 302, and 303 or equivalent; knowledge of differential and integral calculus and physical chemistry. Staff.
- 420. Neural Correlates of Behavior.** A lecture course designed to give the student an understanding of behavioral mechanisms from an integrated view of neuroanatomy, neurophysiology, and endocrinology. Quarter to be an-

nounced (alternate years). 3 quarter hours. Prerequisite: Physiology 301, 302, and 303 or equivalent; Anatomy 303 (Neuro) or permission of instructor. Staff.

- 421. Physiology of Hearing.** A critical survey of current theory and experimental data about the auditory and vestibular processes beginning at the ear and ending in the cerebral cortex. The course is designed to introduce the basic physiologic principles involved in sensory analysis and integration by the cortex and their synthesis into an apperceptive experience. The functions of the ear will be compared with other sense organs. Three lecture-conference hours per week. W. 4 quarter hours. Prerequisite: Physiology 301, 302, and 303 or equivalent. Derbyshire.
- 422. Vestibular Physiology.** The vestibular apparatus, as the most ancient sensory organ, is best suited for studying the principles of sensory organ physiology. Its evolution from the still existing primitive level to its complex and extensive appearance in man is followed. The mechanism of the receptor system, the neural centers, and the vast reflex arc are discussed. Two hours per week. Lectures, laboratory, discussion. W. 3 quarter hours. Prerequisite: Physiology 301, 302, and 303 or equivalent. Torok.
- 440. Special Topics in Physiology.** Selected topics in bioengineering, endocrinology, neurophysiology, cardiovascular and sensory physiology, energy, water, and electrolyte metabolism, or other announced topics each time course is offered. Lectures, discussions. F. W. Sp. S. 3 quarter hours each quarter. Prerequisite: Physiology 301, 302, and 303 or equivalent. Staff.
- 471. Methods in Experimental Physiology.** A laboratory course designed to acquaint students with advanced techniques and methodology in physiologic investigations. Primarily for students in physiology. Registration limited to ten. Sp. 3 quarter hours. Prerequisite: Credit or registration in Physiology 301, 302, and 303, or equivalent. Staff.
- 486. Cell Physiology.** The structural and functional characteristics of cells. A course designed to introduce students to the cellular bases of physiological activity. Organization, function, and interaction of cell membranes, cytoplasmic particulates, and the nucleus, and fundamental physicochemical principles relevant to cell biology. Three one-hour lectures, one conference, and required reading per week. Quarter to be announced. 5 quarter hours. Prerequisite: Biochemistry 301, 302; credit or registration in Physiology 301, 302, or 303. Loizzi, Omachi.
- 488. Transport Across Cell Interphases.** Discussion of basic mechanisms underlying transport of water, electrolytes, and non-electrolytes across biological membranes. Three one-hour lectures per week. Quarter to be announced (alternate years). 3 quarter hours. Prerequisite: Physiology 301, 302, and 303, Biochemistry 301, 302; or consent of instructor. Omachi.
- 491. Seminar in Physiology.** F. W. 1 quarter hour each quarter. Prerequisite: Credit or registration in Physiology 301, 302, and 303, or equivalent. Staff and distinguished guests.

493. **Research in Physiology.** F. W. Sp. S. 1 to 16 quarter hours each quarter. Prerequisite: Credit or registration in Physiology 301, 302, and 303, or equivalent. Staff.
494. **Tactics and Strategy of Research in Physiology.** In this seminar there will be an analysis of the various approaches which have been of recent importance in solving problems in physiology. New techniques, preparations, or new designs which have been instrumental in advancing physiology will be discussed and analyzed in depth. F. W. Sp. 2 quarter hours each quarter. Prerequisite: Consent of instructor; registration limited. Staff.

BIOENGINEERING COURSES

366. **Signals and Systems.** An introduction to control theory, specially designed for students with backgrounds in the life sciences. Topics will include differential equations, block diagrams, operators, lumped and distributed parameter components, frequency response, and stability of systems with feedback. Four hours per week. F. 4 quarter hours. Prerequisite: Calculus. Staff.
373. **Mathematical Physiology: Central Nervous System.** An intensive treatment of the underlying neurophysiological mechanisms for motor coordination and retinal visual functions brings the systems approach down to the cellular level. Three hours per week. W. 3 quarter hours. Prerequisite: Calculus and consent of instructor. Staff.
407. **Cybernetics.** An introduction to artificial intelligence and pattern recognition by computer. Game-playing and theorem-proving machines, the general problem solver, detection of invariants, network training, decision trees, statistical techniques, voice recognition, character recognition, and electrocardiogram diagnosis by machine. Three hours per week. F. 3 quarter hours. Prerequisite: Calculus and computer programming or permission of instructor. Gose.
408. **Cybernetics.** Continuation of Physiology 407. Reliable brains from unreliable neurons, self-repairing automata, information processing and storage by multilevel networks, training techniques, learning theories, artificial intelligence, prosthetics and robotics. Three hours per week. W. 3 quarter hours. Prerequisite: Physiology 407. Gose.
409. **Biological Servomechanisms.** Demonstration that many biological systems can be mathematically modelled and analyzed, utilizing techniques developed in control engineering. The approach is through biological examples to provide motivation for successive stages of dynamic analysis and control theory. Laboratory experience with biological control systems including the pupil, eye movement, hand motor coordination, and crayfish tail ganglion systems. Nine hours per week. W. 5 quarter hours. Prerequisite: Physiology 366 and credit or registration in Physiology 301, 302, 303 or equivalent, and consent of the instructor. Staff.

Radiology

The graduate curriculum in radiology leads to the Master of Science de-

gree. Graduate work in the field of radiology is provided to stimulate the development of critical investigators and intelligent teachers. Facilities are available for research on monochromatic and high intensity soft radiations, on the cobalt unit in its relationship to applied physics and radiobiology, and in the field of experimental and clinical application of radioactive isotopes.

The Doctor of Medicine or Doctor of Dental Surgery is required, except that undergraduate students may be accepted on a selective basis if they are pursuing work toward the Doctor of Medicine degree and meet the general admission requirements of the Graduate College. The Master of Science degree is not awarded before completion of requirements for the Doctor of Medicine degree.

Courses required of all candidates are Radiology 401, 402, 403, or Pharmaceutical Chemistry 325 and at least 20 quarter hours in Radiology 493, and one seminar in a basic science per quarter for three quarters. Attendance is also required at conferences and seminars.

The thesis must be based on an original investigation.

GRADUATE TEACHING FACULTY

Professors: HORACE C. DUDLEY (Radiological Physics), ROGER A. HARVEY.

Assistant Professor: ROBERT E. POLCYN.

COURSES FOR GRADUATES

401. **Radiation Physics for Medical Application.** Weekly conferences on theory, mathematics, mechanics, production, detection, and protection from radiation sources; discussion on radiobiology; analysis of pertinent clinical and research problems. Intended for advanced graduate students using radiant energy. F. 2 quarter hours. Dudley.
402. **Radiation Physics for Medical Application.** Continuation of Radiology 401. W. 2 quarter hours. Dudley.
403. **Radiation Physics for Medical Application.** Continuation of Radiology 402. Sp. 2 quarter hours. Dudley.
410. **Radioactive Isotopes.** Fundamentals of radioactivity are discussed in terms of simple theory, biological effects, and experimental and clinical uses. Stress is placed upon proper techniques for handling, using, storing, and disposing of these hazardous materials. F. W. Sp. 3 quarter hours (1 quarter hour each quarter). Dudley, Harvey, Polcyn.
493. **Research in Radiology.** Research in the physical and biological aspects of radiography and radiotherapy, using such instruments as monochromatic beams, isotopes, and the cobalt unit. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

Surgery

Graduate training in surgery leading to the Master of Science degree is designed primarily to aid in the acquisition of knowledge of the basic sci-

ences related to surgical problems. The candidate must devote the major portion of his time to research. Work in the basic sciences is essential for a well-trained scientific surgeon, but this work alone is not sufficient to qualify a candidate for a degree. He must also be cognizant of the clinical and scientific phases of preoperative and postoperative care as well as surgical convalescence, and this knowledge cannot be achieved by a pursuit of basic sciences alone. He must also become exposed to the art of surgical techniques, though the time so devoted shall not apply toward credit in the Graduate College.

A Doctor of Medicine degree is required for admission with the exception that medical students who have completed one year of the medical curriculum may apply if they fulfill the general requirements for admission to the Graduate College. Such candidates are not granted a graduate degree until they have completed requirements for the Doctor of Medicine degree.

The candidate is required to obtain at least ten quarter hours in research courses and five quarter hours in formal courses in the 400 series, exclusive of seminar courses. The formal graduate course requirements should be met by taking courses offered in the basic sciences which support the student's research interests. Attendance at surgical-pathology conferences, journal club, and surgical research seminars is required. A thesis reporting the candidate's research must be submitted and defended.

GRADUATE TEACHING FACULTY

Professors: ROBERT E. CONDON, TAPAS DAS GUPTA, STEVEN G. ECONOMOU, ORMAND C. JULIAN, DAVID M. LONG, JR., GERALD O. McDONALD, LLOYD M. NYHUS, CHARLES B. PUESTOW, MAX SADOVE, WILLIAM SCHUMER.

Assistant Professors: OLGA JONASSON, GERALD S. MOSS.

COURSES FOR GRADUATES

491. **Surgical Seminar.** Discussion of research problems, review of important literature, presentations of research in progress. Discussion of recent advances in research by staff and visiting scientists. F. W. Sp. S. 3 quarter hours each quarter.
493. **Research in Surgery.** Research investigations of problems in surgery, exclusive of technique. F. W. Sp. S. 1 to 16 quarter hours each quarter. Staff.

**FIELDS OF INSTRUCTION LEADING TO A
PROFESSIONAL GRADUATE DEGREE**

Nursing—M. S. N. Degree

A five-quarter program of advanced study leading to the Master of Science in Nursing (M.S.N.) degree offers study in one of several clinical nursing areas. Presently, courses in medical-surgical nursing and psychiatric nursing are available. Courses in maternity nursing, pediatric nursing, and public health nursing are planned for the near future. Concomitant study in either supervision or teaching is encouraged. Courses in advanced clinical nursing and in related fields of knowledge, statistics, and research methodology are required. Supporting courses for the clinical and functional areas include courses in the biological and behavioral sciences and in other departments, e.g., education and management. Other courses may be elected by the student in areas of individual need or interest.

CURRICULUM PATTERN

For the Master of Science in Nursing, a minimum of 65 quarter hours is required in the 300 and/or 400 series. These quarter hours are to be distributed as follows:

	<i>Quarter Hours</i>
Clinical Specialty Courses	5-6
Research and Statistics	
Research	2 for quarters 1-2-3
Research (elective)	0-5 for quarters 4-5
Statistics	2-5
Supporting Courses and Electives.....	0-10 per quarter
Seminar.....	2 for 2 quarters

From the above curriculum pattern a variety of programs can be planned to meet the individual needs of graduate students and at the same time meet the minimum requirements of 65 quarter hours.

OBJECTIVES

1. Develop expertness in the practice of one clinical field of nursing.
2. Develop competence in utilizing clinical expertness in either teaching of nursing or supervision of nursing services in a specific area.
3. Learn investigative skills needed to expand the body of knowledge upon which nursing practice is based.
4. Develop further the ability to collaborate with other professionals in the health field.
5. Deepen commitment to the utilization of professional competence to further the objectives and the services of the profession.

ADMISSION

Admission may be granted to those who have completed a Bachelor of Science degree in nursing, substantially equivalent to the baccalaureate degree program of the College of Nursing, University of Illinois. A minimum scholastic average of 3.5 (midway between B and C) in undergraduate work is required. Those whose average is less than 3.75 must take the Graduate Record Examination. Each applicant must be licensed to practice as a professional nurse in at least one political jurisdiction and must pass an examination required by the Department of Nursing to determine basic skills and knowledge as well as potential for professional practice in an elected field of specialization.

Requests for admission should be directed to the College of Nursing. All application data, including application forms, transcripts, letters of recommendation, Graduate Record Examination scores, and requests for financial aid, should be forwarded to the Office of Admissions. Inquiries about financial aid should be addressed to the Office of the Dean, College of Nursing. A personal interview with a graduate adviser in the College of Nursing is desirable and in some instances may be required.

Requirements for graduation include the completion of the five-quarter curriculum with grades, courses, and hours which meet the general requirements of the Graduate College, satisfactory completion of a thesis on a subject approved by the major adviser, and sustaining an oral examination on the thesis conducted by a committee appointed by the Dean of the Graduate College. Completion of all requirements for the degree of Master of Science in Nursing (M.S.N.) must be realized within five calendar years after first registration in the Graduate College. Except where otherwise indicated, the general policies of the Graduate College will apply to graduate work conducted in advanced nursing disciplines. Students who wish to pursue work toward the Ph.D. degree in a basic science discipline must fulfill the requirements of the Graduate College and the department for admission.

GRADUATE TEACHING FACULTY

Professors: LAWRENCE FISHER, MARY K. MULLANE, VIRGINIA OHLSON, LILLIAN RUNNERSTROM, MELVIN SABSHIN, GERTRUDE STOKES.

Associate Professors: HERBERT BESSINGER, RACHEL BLISS, EMILY C. CARDEW, GLADYS COURTNEY, HELEN DUNN, MAURICE JOSEPH, JOAN KING, LEO LEVY.

Assistant Professors: ANDREA BIRCHER, RUE BUCHER, LUCILLE DAVIS, HERMAN DIESENHAUS, HELEN GRACE, SHIRLEY HEINZE, SAMUEL HUNG, LILLIAN OERTEL, AGNES REZLER, KATHLEEN SMYTH.

Lecturers: DOROTHY CAMILLERI, HERBERT WEINSTEIN.

COURSES FOR GRADUATES

309. Dynamics of Small Groups. Study of factors influencing effective group

functioning. Special emphasis upon emotionality, focal conflicts, decision making, and leadership. 5 quarter hours. Weinstein.

- 370. Curriculum and Instruction.** A study of instruction, learner interaction with his environment, including the teacher; sources and identification of educational objectives; selection of learning experiences and instructional methods appropriate to the desired outcomes; organization of learning experience; appraising educational results. Faculty members' role in curriculum evaluation and revision. Emphasis on general principles with specific application to education for professional nursing. Three hours of lecture discussion per week. 2 quarter hours. Fisher.
- 383. Principles of Administration.** Principles, objectives, and methods of administration applied to management of a clinical nursing division in a modern hospital. "Classic" approaches to management; review of hospital structure and function; organization and direction of a clinical nursing division; administration as leadership. Three hours of lecture and discussion per week. 2 quarter hours. Dunn, Mullane.
- 385. Social Statistics.** A study of quantitative methods in the behavioral sciences: topics include tabular and graphic presentation of data, elementary probability, random variables and theoretical frequency distributions, estimation, Cr, Chi Square, regression, correlation, and one way analysis of variance. 2 quarter hours. Derrick.
- 399. Sociological Analysis of Hospital Settings.** Study of the basic sociological principles, review of relevant research, and analysis of psychiatric hospital problems from a sociological perspective. 2 quarter hours. Bucher.
- 406. Contemporary Trends in Community Mental Health.** A review of contemporary thought on socio-psychological approaches to community psychiatry and prevention of mental illness. The public health model will be explored and application to mental health discussed. Prerequisite: Successful completion of first three quarters of graduate program or consent of instructor. 2 quarter hours. Levy.
- 474. Practice Teaching in Nursing.** Guided experience in teaching nursing in both classroom and clinical settings. Students will have opportunity to develop, teach, and evaluate the outcomes of a unit in the content of their clinical specialty, including evaluating and counseling students in clinical practice. Twelve hours per week in observation, conference, and practice. 4 quarter hours. Prerequisite: Nursing 370 and 478, or equivalent. Staff.
- 478. Evaluation in Nursing.** (Same as Education 391. Construction and Use of Tests in Teaching.) A study of the purposes, principles, and methods appropriate to determining degree of progress toward desired goals in education and nursing practice. Theory of measurement and principles of item writing and test construction. Methods of appraising nursing care and the evaluation of practitioners of nursing and of student progress in clinical experience. Emphasis on the use of the evaluation program to improve nurs-

ing care, facilitate learning, and evaluate the total program (curriculum or institutional). 2 quarter hours. Rezler.

- 487. Practice Supervision in Clinical Nursing Services.** Guided experience in planning, organizing, and managing a clinical division of a hospital nursing service in the student's clinical specialty. Includes opportunity to observe and to participate in the supervisory role; planning a supervisory program; designing strategy for effecting change and for evaluating supervisory outcomes. Twelve hours per week in observation, conference, and practice. W. 4 quarter hours. Prerequisite: Nursing 383. Dunn, Mullane, and Staff.
- 491. Seminar in Nursing.** Identification and analysis of problems in modern health care and their impact upon education for nursing, preservice and inservice; of organizing and administering programs of patient care in hospitals and outpatient services; review of relationships between nursing education and nursing service, and critique of some new proposals. 2 quarter hours each quarter. Mullane and Staff.
- 493. Research in Nursing I, II, III.** A three-quarter sequence of introduction to research. Logic of Inquiry; Search and Formulation of Problems; Methods and Designs of Problem-oriented Research; Fundamentals of Data Collection; Mechanics of Data-Processing; Data Analysis and Interpretation; Fundamentals of Reporting and Presentation of Research Findings. F. W. Sp. 2 quarter hours each quarter. Hung.
- 493. Research in Nursing IV, V.** Guidance with student's individual research project. Requires consent of major advisers. 0 to 5 quarter hours each quarter. Hung.

Psychiatric Nursing Sequence

COURSES FOR GRADUATES

- 350. Advanced Psychiatric Nursing.** Institutionalized settings. Concentrated study of nursing diagnosis, therapeutic intervention, and assessment. Discussion of the role of the psychiatric nurse as an individual practitioner and as colleague in an interdisciplinary team. Exploration of basic interpersonal and psychoanalytic concepts. Lectures, discussions, and demonstrations. Requires concurrent registration in Nursing 350-L. F. 3 quarter hours. Bircher, Camilleri, King, Stokes.
- 350-L. Laboratory Practice in Psychiatric Nursing.** Supervised practice within psychiatric settings, correlated with instruction in Nursing 350; must be taken simultaneously. F. 2 or 3 quarter hours. Staff.
- 451. Advanced Psychiatric Nursing.** Psychopathology. Concentrated study of individual and group psychotherapy. Discussion of major psychopathological syndromes and functions of the psychiatric nurse in special situations requiring specific nursing action. Lectures, discussions, and demonstrations. Requires concurrent registration in Nursing 451-L. W. 3 quarter hours. Bircher, Camilleri, King, Stokes.

- 451-L. Laboratory Practice in Psychiatric Nursing.** Supervised practice within psychiatric and clinic settings, correlated with instruction in Nursing 451; must be taken simultaneously. W. 2 or 3 quarter hours. Staff.
- 452. Advanced Psychiatric Nursing.** Family therapy. Study of the psychotherapeutic approach to groups and the family unit. Exploration of systems theory and application to families. Special emphasis on theory and nursing intervention related to communication, roles, and healthy forces within the family. Lectures, seminars, and demonstrations. Requires concurrent registration in Nursing 452-L. Sp. 3 quarter hours. Bircher, Camilleri, Grace, King, Stokes.
- 452-L. Laboratory Practice in Psychiatric Nursing.** Supervised practice within psychiatric settings, clinics, and community correlated with instruction in Nursing 452; must be taken simultaneously. Sp. 2 or 3 quarter hours. Staff.
- 453. Advanced Psychiatric Nursing.** Community mental health. Study of the community-related factors involved in the nurses' approach to prevention of illness, treatment, and rehabilitation of people with emotional disorders. Lectures, discussions, and demonstrations. Requires concurrent registration in Nursing 453-L. F. 3 quarter hours. Grace, King, Stokes.
- 453-L. Laboratory Practice in Psychiatric Nursing.** Observation and supervised practice within community agencies, correlated with Nursing 453; must be taken simultaneously. F. 2 or 3 quarter hours. Staff.

Medical-Surgical Nursing Sequence

COURSES FOR GRADUATES

- 320. Advanced Medical-Surgical Nursing.** Analysis of nursing and its basic or fundamental elements with emphasis on the independent nursing functions. Focus will be on selecting, analyzing, and synthesizing scientific data essential to professional nursing. To be taken simultaneously with Nursing 320-L. F. 3 quarter hours. Smyth and Staff.
- 320-L. Laboratory Practice in Medical-Surgical Nursing.** Observation and supervised practice within medical-surgical settings, correlated with instruction in Nursing 320; must be taken simultaneously with Nursing 320. F. 2 or 3 quarter hours. Smyth and Staff.
- 421. Advanced Medical-Surgical Nursing.** Concentrated study of the care vital to patients with cardiovascular-renal disorders, and the role of the nurse in prevention of these disorders. Focus is on intellectual activity for the purpose of identifying principles and key concepts. To be taken simultaneously with Nursing 421-L. W. 3 quarter hours. Smyth and Staff.
- 421-L. Laboratory Practice in Medical-Surgical Nursing.** Observation and supervised practice within appropriate settings. Correlated with instruction in Nursing 421. Must be taken simultaneously with Nursing 421. W. 2 or 3 quarter hours. Smyth and Staff.
- 422. Advanced Medical-Surgical Nursing.** Intensive study of the nursing care

of patients with selected long-term disabilities or illness. Focus is upon intellectual activity to integrate knowledge from the biological, sociological, and psychological sciences. To be taken simultaneously with Nursing 422-L. Sp. 3 quarter hours. Smyth and Staff.

422-L. Laboratory Practice in Medical-Surgical Nursing. Observation and supervised practice within settings appropriate for correlation with Nursing 422. Must be taken simultaneously with Nursing 422. Sp. 2 or 3 quarter hours. Staff.

423. Advanced Medical-Surgical Nursing. Independent study in a special interest area of medical-surgical nursing. To be taken simultaneously with Nursing 423-L. F. 3 quarter hours. Smyth and Staff.

423-L. Laboratory Practice in Medical-Surgical Nursing. Devoted to problems and investigation in special interest area. Must be taken simultaneously with Nursing 423. F. 2 or 3 quarter hours. Smyth and Staff.

GRADUATE COLLEGE

Elective Courses for Graduate Credit

The following courses offered at the Medical Center campus are in areas which have no graduate degree programs. They are available as electives in all disciplines upon approval of the major adviser. They carry a Graduate College number for identification.

Graduate College 310. Digital Computer Programming, I. (Basic Fortran.)

Introduction of principles oriented toward biomedical applications and research. Purpose of computer, Digital versus Analog computer, the programming system. Basic Fortran-program analysis, Fortran statements, flow charting, coding, examples, and applications. This course is designed for basic applications and does not require special mathematics as a prerequisite. The IBM 1620 computer will be available for exercises. Time to be arranged. 4 quarter hours.

Graduate College 360. Differential Equations. First-order equations, linear equations of higher order, reduction of order, power series. Partial differentiation and integration, equations of order one, linear equations. Applications to physical problems in the health sciences. Four class meetings each week. Sp. (alternate years). 4 quarter hours. Prerequisite: Calculus. Grundman.

Graduate College 362. Probability and Statistical Inference, I. The theory of probability; averages; dispersion; theory and techniques of sampling; testing of hypotheses. Applications to problems in the health sciences. Four class meetings each week. W. 4 quarter hours. Prerequisite: Calculus. Grundman.

Graduate College 363. Probability and Statistical Inference, II. Estimation; Chi Square distribution; curve fitting; correlation; the analysis of variance; nonparametric statistics. Applications to problems in the health sciences. Four class meetings each week. Sp. 4 quarter hours. Prerequisite: Graduate College 362. Grundman.

Graduate College 365. Matrices, Vectors, and Linear Transformations. Matrix algebra; determinants, inverse of a matrix, rank, and equivalence; linear equations and linear dependence; vector spaces and linear transformations. Applications to physical problems in the health sciences. Four class meetings each week. Sp. (alternate years). 4 quarter hours. Prerequisite: Calculus. Grundman.

Graduate College 401. Biometrics and Applied Statistics. This course is designed as an introduction to the rational use of simple statistical methods in the planning of experiments and evaluation of results. S. 5 quarter hours.

EDUCATION

No degree program is administered in Education but the following courses are available as electives:

- 391. Construction and Use of Tests in Teaching.** The purposes and principles of evaluation and methods of appraising student achievement in knowledge, skills, and attitudes. Emphasis on the use of evaluation instruments to improve student performance, facilitate learning, and evaluate instructional programs in the health sciences. Two hours per week. 2 quarter hours. Rezler.
- 439. Fundamentals of Course and Curriculum.** Concepts and principles of course development, skills and principles of course development, skill in analyzing curricular patterns in medical education, and skill in designing a course to meet specific needs in biomedical science education. Three hours per week. 3 quarter hours. Telder.

BY ARRANGEMENT IN ANY QUARTER (FALL, WINTER OR SPRING)

Practice Teaching Supervision (hours by arrangement). This program is designed to assist the student-teacher develop his instructional skills in the use of the lecture, laboratory, exercise, and group discussion. Observational analysis and videotape playback will be available to assist the instructor in his critique. The participant must have a variety of teaching opportunities within his department in his role as a teaching assistant. No credit. Pochyly.

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